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THE AMERICAN GAS LIGHT JOURNAL

REDMANKENNY.N.Y.

PUBLISHING OFFICE No. 32 PINE STREET

DEVOTED TO THE INTERESTS OF ILLUMINATION, HEATING, MECHANICAL, CHEMICAL AND GENERAL SCIENCE.

VOLUME LXXII. No. 2. Whole No. 1,283. | NEW YORK, MONDAY, JANUARY 8, 1900. | $4 PER ANNUM, IN ADVANCE.

A. M. CALLENDER & CO., Proprietors. C. E. SANDERSON, Manager. THOMAS J. CUNNINGHAM and ELBERT P. CALLENDER, Editors.

ENTERED AT THE POST OFFICE AT NEW YORK, N. Y., AS SECOND-CLASS MATTER.

Published on each Monday of the year, at No. 32 Pine Street, New York.

Collections are invariably made directly from this office for subscriptions, advertisements, etc. We have agents to solicit the same, but they are not authorized to receipt for money.

Terms of Subscription, Including Postage —For the United States and Canada, $3 per annum. European countries, $5 (£1—25 francs). All payments to be made in advance. Single copies, 10 cents.

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[OFFICIAL NOTICE.]

Cost of Proceedings, Western Gas Association, to Non-Members.

WESTERN GAS ASSOCIATION, OFFICE OF THE SECRETARY,
NEW ALBANY, IND., Sept. 29, 1899.

Bound copies containing the Proceedings of the Western Gas Association for the years 1896–97–98 can be obtained for the sum of $2 each. Make your remittances payable to the Secretary.

JAMES W. DUNBAR, Secy.

BRIEFLY TOLD.

A BURNING KENTUCKY QUESTION.—If Kentucky were to be judged by its geographical position, in so far as its relation to the other States of the Union is concerned, it must be conceded that it should be always cool, if not capable. But the trouble is that Kentucky experiences wide, variable differences in its climate—its summers at times being too hot and its winters too cold; so, it may be taken for granted that, as its summers are warm and its winters are cold, the temperatures of its residents will change. When the temperature of a resident changes trouble is likely to result; and our colums this week bear evidence to the change of temperature in a resident of Louisville, whose name is Donald McDonald, and whose position is President of the Kentucky Heating Company, of Louisville, the mission of whose Company was to furnish and sell "natural gas" in and about Louisville, "for heating purposes only." In our item columns for this week Mr. McDonald makes his complaint against a second ruling of the Board of Public Works, of Louisville, regarding when and under what condition his Company may take on consumers "of natural gas" for fuel purposes only; but in his complaint, and in his submission thereto to the effects thereof, he admits that he is willing to wait until the courts overrule the Board of Public Works, which means, remembering the seasonable state, that, at the present time, he is up to the limit of supply, regarding any "natural" or supplementive sources that are at his command. The gentleman named declares that he suffers from the imputation that his Company made an agreement and then violated it; in fact he also declares that "We cannot, however, and will not, rest under the charge of having made an agreement and then violated it." Well, then, what is an Easterner going to do when confronted with evidence which goes to show that things are not what they seem? In plain view of the writer is a letter head of Mr. McDonald's Company. Omitting the names of its officers, and the Company has officers in plenty (a President, First Vice-President, Second Vice-President, Secretary and Engineer, but no Treasurer), we come to its official title, which is that of the "Kentucky Heating Company (incorporated), Natural Gas." May we ask what the significance of natural gas is? May we further ask what the existence on the premises of the Kentucky Heating Company of artificial gas generators means? Yes, we may; further we will venture to reply to our own question. Our reply is this: For people who cannot and will not rest under the charge of having made an agreement and then violated it, the managers of the Kentucky Heating Company are doing quite well. They should, however, change the nomenclature of their letter heads, while posing as purists, for fear that, by their own publishing, the "Company's" sins should be revealed to too many.

"TRANSACTIONS" TO HAND.—We have to acknowledge the receipt of a copy of the "Transactions" of the "Société Technique de l'Industrie du Gaz en France," the sessions for the past year of which were held in Paris last June, under the Presidency of M. Theophile Vautier. Heretofore we mentioned the success of this meeting, which was attended by 247 members, and referred to the hope there expressed that, at the exhibition of the world's industries, to be held in Paris during the year which marks the close of the Twentieth Century, the Gas Associations of America would be properly represented by regularly accredited delegates at the gas congress, to be a feature of the exposition in September next. So far but two of our Societies have taken official action respecting the invitation—last October the American Gas Light Association sent its whole body, or those thereof who could go, as representatives *à la omnibus*, and the Society of Gas Lighting did likewise. It is to be hoped that the New England, the Ohio and the Western Associations will have sufficient nerve and money to designate out of their members one to represent them each officially at this universal congress of gas men, for such commingling will be well worth all that shall have been expended upon it. The supineness of the English speaking gas men, in respect of their fraternizing with those who converse in other languages, is remarkable; and especially so in respect of the fact that it is not yet fully established whether Murdock, of England, or Lebon, of France, should have the award of having been the first to put beyond peradventure the success of the distribution of gas from a central house. In our best wishes we hope that the New England Association of Gas Engineers will officially next month name its President to represent it at the French Congress, and that the Ohio will follow suit—at no time have we had any doubt that the Western Association will be represented at the Paris Congress. However, this is all apart from due consideration of our receipt of the volume recording the transactions of the 26th meeting of the French Association. As usual the tome is in pearl gray binding, its printing and paper are good, and its matter is a faithful transcript of that which was said and done at the numbered gathering. In queer contrast to the pearl gray binding of the "Transactions" of the French Society is the volume containing the "Transactions" of the Incorporated Gas Institute, England, for 1899. In its sombre panelling one would imagine a missal before him, for the panelling is done on dark leather, although the titling has a gilded typing. Our copy of the "Transactions" is due to the thought of Mr. Walter T. Dunn, the clever Secretary of the Institute, and we may not say more for the book than it reflects credit upon its arranger. As to its contents, we may not say much just now, since the most of the Institute's transactions, so far as the set papers read before it last June are concerned, have since been given in our columns. The book is well worth a place in the library of every gas man.

NOTES.—Mr. Charles W. Blodget has resigned from the service of the Brooklyn Union Gas Company.——Mr. John C. Lowry has been elected President of the American Gas Company, and his headquarters will be in the home offices of the Company, No. 222 South Third street, Philadelphia. He succeeds Mr. Edmund H. McCullough, who declined to serve the Company longer in the capacity of its executive head. Our best and heartiest wish for President Lowry is that his administration of the American Company's affairs will equal that which accompanied Mr. McCullough's direction thereof.——The Rochester (N. Y.) *Republican* says that the Dansville (N. Y.) Gas and Electric Light Company has been purchased by Messrs. E. F. Kizer and F. L. Smith, of Towanda, Pa., and S. N. Blake, of Elmira, N. Y. It is understood that separate rates will be made for gas used on lighting and fuel account, and that the plant will be generally overhauled. It (the plant) will certainly stand some rejuvenation.——The New Orleans (La.) Gas Light Company, according to its Secretary, Mr. Duncan Jones, will pay a dividend of $2.50 per share on the 15th inst.——The Detroit (Mich.) *Tribune*, of December 29th said: "The Kalamazoo (Mich.) Gas Light Company has been reorganized under the name of the Kalamazoo Gas Company. The following officers were elected: Directors, Edward Woodbury, C. A. Peck, J. W. Thompson, J. J. Knight, I. A. Ransom, H. D. Walbridge and H. B. Osborne; President, H. D. Walbridge; Vice-President and General Manager, J. J. Knight; Secretary and Treasurer, Edward Woodbury. The reorganizers it is said will rebuild the plant next spring.——Send to the United Gas Improvement Company for a copy of its 1900 calendar.——The Hartford (Conn.) City Gas Light Company has purchased the Perry Smith property on the north side of Arch street, close to the corner of Front street. Can it be that General (or President?) Harbison's Company needs a new holder.

On the Determination of Volatile Combustible Matter in Coke and Anthracite Coal.[1]

By MR. RICHARD K. MEADE and MR. JAMES C. ATTIX.

Some years ago a discussion arose between the consumer and the manufacturer of a coke as to its value. The user objected to the high ash, and in support of his claim gave the analysis of his chemist, in which the ash was reported at 18 per cent. The maker replied that the analysis was worthless, as the chemist who made the analysis was probably incompetent, since he had reported nearly 3 per cent. of volatile combustible matter, and that in a 72 hour coke the volatile combustible matter could not be nearly so high. The question was referred to a well known analytical chemist. His analysis, while agreeing with that of the consumer's chemists in the percentage of ash, gave the volatile combustible matter as $\frac{6}{10}$ per cent. The consumer's chemists then checked their work, and still found over 3 per cent. of volatile combustible matter. They used the method of heating a 1-gram sample for 3½ minutes over a Bunsen burner and then, for the same length of time, over a blast lamp, reporting the loss after deducting the percentage of moisture (found on another sample) as volatile combustible matter. A letter to the referee brought out the fact that he used a 10-gram sample and heated for the same length of time. The only excuse the consumer's chemists could give their employers was, that they used the method published in Blair's standard work on the analysis of furnace materials and products, and that this was the method usually published in works on metallurgical analysis.

Of the commonly published methods for the determination of volatile combustible matter in coke and anthracite coal, none reach anywhere near even approximation. The method of Hinrichs[2] which, by the way, he recommends for soft coal and says nothing about coke or anthracite, gives far from true results; nor is the method even comparative. Heating first over a Bunsen burner and then over a blast lamp drives off volatile matter and traces of moisture, and *burns some carbon*. The loss occasioned by the latter in many cases amounts to several times that by the two former occurrences. This burning may be prevented by heating the sample in a non-oxidizing atmosphere, such as nitrogen. The loss after such a heating will represent the volatile products driven off by a high temperature. What these products are it is not our purpose to discuss. Probably even when the sample has been thoroughly dried moisture is among them.

The determination of volatile combustible matter in coke is worth doing well or worth doing not at all. If the determination of volatile combustible matter is used for checking the coking of the coal, it is an important determination of itself, and so long as the determination of the fixed carbon depends upon a knowledge of the volatile combustible matter, it is a necessary one indirectly, for, if the volatile combustible matter is one or two per cent. above what it should be, by just so much will the fixed carbon fall short of the true percentage.

The following investigation, looking toward a more satisfactory method of determining volatile combustible matter, in coke and anthracite, was undertaken by the writers over two years ago, and was the outcome of the incident mentioned in the opening paragraph of this paper. The first step was to heat samples of coke in nitrogen, determine the loss and call such loss "volatile combustible matter" after subtracting the moisture, driven off by one hour's heating at 110° C. The method of procedure consisted in weighing samples of from three to four grams of coke into a small platinum dish, placing this in the crucible of the carbon apparatus described by Dr. Porter W. Shimer in the July number of this *Journal* and passing a slow current of nitrogen through the apparatus until the air had been driven out. The nitrogen used was prepared by heating together saturated solutions of potassium nitrite and ammonium chloride. The gas was kept in glass gasholders, and freed from oxygen by passing through cuprous chloride dissolved in hydrochloric acid. The gas was dried just before use by passing through calcium chloride tubes, placed in front of the crucible. The exit tube from the crucible dipped into strong sulphuric acid, keeping any moisture or air from getting back into the crucible. After passing through the crucible for half an hour the current of nitrogen was slackened, a low flame placed under the crucible, the water cooling apparatus started and the heat then carefully raised. After heating the coke for a few minutes over the full Bunsen flame, the blast lamp was made to replace the latter and a high temperature maintained for 10 or 15 minutes. The sample was cooled in the current of nitrogen, removed, and weighed. Below are a few results upon a

1. *Jour. Am. Chem. Soc.*
2. *Chem. News*, 18, 53.

sample of coke which had been dried for one hour at a temperature of 110°C.

After heating three grams over a blast lamp for 15 minutes, the loss was found to be 0.31 per cent. After again heating, an additional loss of 0.0003 gram or 0.01 per cent. occurred.

After heating three grams for 10 minutes over a blast lamp, the loss was 0.0090 gram or 0.30 per cent. After again heating, an increase of 0.0001 gram or 00.3 per cent. occurred.

After heating three grams over a blast lamp for 6 minutes, the loss was 0.0095 gram or 0.32 per cent. On again heating, the sample lost 0.0002 or 0.007 per cent.

Heating in hydrogen was also tried and gave practically the same result. The losses from four determinations were 0.31, 0.31, 0.29 and 0.30 per cent.

At the time these investigations were undertaken, we supposed the idea of heating in nitrogen was original with us. A letter from Mr. W. H. Blauvelt, of the Semet Solvay Company, of Syracuse, N. Y., however, informed us that the method essentially as worked out by us was used in his laboratory and also in various technical and commercial laboratories in England and in Germany. Hydrogen, answering apparently as well as nitrogen, replaced the latter in most of these laboratories.

Samples of coke and anthracite were carefully standardized by heating in nitrogen and the volatile combustible matter then determined by various methods in common use.

The method commonly published of heating one gram for 3½ minutes over a Bunsen burner, and then for the same length of time over a blast lamp, was first investigated. A sample of Pocahontas (West Virginia) coke losing, on heating in nitrogen, 0.61, 0.62 and 0.60 per cent. was used in the experiments.

We noted the following points—different operators get widely varying results as these determinations will show :

Operator.	Per Cent. of Volatile Combustible Matter.	True Per Cent. of Volatile Combustible Matter.
A	3.01	0.61
B	2.51	0.61
C	2.36	0.61
D	2.25	0.61

This variation is due to the size of the crucible, the tightness of the joint between the crucible and its lid, the height at which the crucible is placed above the flame and the size of both Bunsen burner and blast lamp flames. A large crucible will give a higher result than a small one, because the larger the crucible the more air will be present, and consequently the more coke will be burned and the greater the loss will be on ignition. Below are some results on this.

Size of the Crucible.	Per cent. Volatile Combustible Matter.
12 cc	1.96
12 "	1.90
16 "	2.10
16 "	2.21
21 "	2.56
21 "	2.58
30 "	3.19
30 "	3.42

Since the burning takes place only on the surface of the sample, the shape of the crucible would also affect the result. In a narrow crucible the loss due to burning of the carbon would be less than in a wide one. In all of the above experiments crucibles of the usual forms were used. Of course the fit of the lid makes a great difference. Dr. Porter W. Shimer, in order to effect a close joint between the crucible and the lid, uses a thin piece of wet asbestos paper. This lessens considerably the quantity of carbon burned.

Ignition over different burners or blast lamps gives varying results. A large flame, other things being equal, will burn more carbon than a small one. A few results will show the variation one may expect :

Burner. No.	Blast. No.	Loss on Ignition, Per Cent.
1	1	2.12
1	1	2.20
2	1	2.31
2	1	2.39
1	2	2.91
1	2	2.80
2	2	3.00
2	2	3.11

The results by this method are not even comparative, because some cokes burn more readily than others. A soft coke burns more readily than a hard one. A sample of Connellsville coke containing 0.65 per cent. of volatile combustible matter, as determined by heating in nitrogen, gave 2.31 per cent. by heating in a covered crucible. Another sample of Connellsville coke gave 0 21 per cent. of volatile combustible matter on heating in nitrogen, and 2.66 per cent. on heating in the same covered crucible, over the same burner and blast lamp, and under as nearly the same conditions as it was possible to obtain. In this instance a coke containing only one-third as much volatile combustible matter as another gave by this method 0.35 per cent. more.

The fineness to which the sample is reduced and the precentage of ash in the coke also probably affect the result.

As the size of the sample increases, a proportionately smaller loss is incurred by burning. There is a limit, however, to which the size of the sample may be carried, for, as the sample increases, the time required to heat the mass of coke to the proper temperature increases also, and a point is reached when the 7-minute heating fails to drive off all the volatile combustible matter. Below is a table showing the effect of the size of the sample on the result.

	Loss on Heating a Dried Sample of the Weight Indicated in a Covered Crucible, for Seven Minutes.					
No. of the Sample.	Loss on Heating Dried Sample in Nitrogen.	One Gram.	Three Grams.	Five Grams.	Ten Grams.	Fifteen Grams.
1. Pocahontas coke	1.24	3 01	2 10	1.61	1.21	0.96
2. New River coke	0.32	1.69	0.93	0.69	0.55	0.47
3. Connellsville coke	0.37	1.49	1.03	0.81	0.52	0.42
4. By-Product coke	0.54	1.61	1.08	0.87	0.60	0.41
5. Pocahontas coke	0.28	1.52	0.90	0.69	0.40	0.38
6. Piedmont (W. Va.)	0.31	2.87	2.00	1.31	0.96	0.54
7. Anthracite coal	2.85	5.10	4.19	3.01	1.87	1.03

The use of a large sample in some cases apparently reaches the same result as heating in nitrogen, but even here the result is chance. A change of burners or crucible will affect a large sample less than a small one, but still quite enough to change the loss considerably. In sample No. 3, Connellsville coke, the use of a large sample in the determination shown in the table gives nearly the same result as is obtained by heating in nitrogen. But on taking a sample from the crucible and reheating in nitrogen an additional loss of 0.17 per cent., or nearly one half of the total volatile matter, was experienced, or, in other words, of the 0.42 per cent. of volatile combustible matter found by heating a 15-gram sample first for 3½-minutes over a Bunsen burner and then for the same length of time over a blast lamp, 0.20 per cent. was due to volatile matter expelled and 0.22 per cent. to carbon burned.

The Committee on Coal Analysis of the American Chemical Society recommend heating the sample of coal over a Bunsen burner for 7 minutes. For soft coals this heating may be sufficient, but for anthracite or coke the blast must be used in order to drive off all the volatile combustible matter. The Committee, of course, did not recommend their method for coke analysis, or at least failed to say so, in their preliminary report.

A sample of coke containing 0.61 per cent. of volatile combustible matter was heated for 7 minutes over a Bunsen burner, then cooled and weighed. The loss was 0.78 per cent. On heating in nitrogen an additional loss of 0.48 per cent. was experienced. The heating over a Bunsen burner in this case was only sufficient to drive off 0.13 per cent. of volatile matter.

A sample of anthracite containing 2.85 per cent. of volatile combustible matter was heated for 7 minutes over a Bunsen burner and then cooled and weighed. The loss was 2.26 per cent. On heating in nitrogen an additional loss of 1.02 per cent. was experienced. The heating over a Bunsen burner in this case drove off 1.83 per cent. of volatile combustible matter.

It is regretted that the larger portion of the work involved by this investigation had been completed before the preliminary report of the Committee on Coal Analysis was published ; consequently the authors were not able to apply this method upon as many samples as they would have liked.

If, after heating a sample of coke or anthracite over a blast lamp and burner for say 7 minutes and weighing, we again heat over the same burners and for the same length of time, the second heating will give us an approximation of the amount of carbon burned in the first. If the loss, therefore, from the second heating is deducted from that of the first the difference will agree fairly close with the loss obtained by heating in nitrogen or hydrogen. The results, theoretically, should fall a little below the results obtained by the latter method, since the volatile matter which is present in the first heating only displaces some

of the air, and consequently there will be more oxygen present in the crucible during the first heating than during the second, and more carbon will be burned. To offset this, there will be slightly less carbon in the crucible upon the second heating, and the coke will be protected somewhat by a slight film of ash formed by the burning during the first. When the sample is small this does not seem to introduce any considerable error, and the results are as apt to be higher as they are to be lower than those obtained by heating in nitrogen. Care must be taken to have the conditions of the second heating similar to those of the first. The same burner and blast lamp must be used; the position of the crucible in the flame and the size of the flames themselves must be the same for each heating.

The timing of the heats must be done with the second hand of the watch or clock, and the flames must be protected from air currents and draughts. To show how closely these blanks agree and the range of accuracy of the methods some results follow:

	Three-Gram Samples Heated for 3½ Minutes over a Burner and then for 3½ Minutes over a Blast give Per Cent. Loss.			
Sample No.	1st Heat.	2d Heat.	3d Heat.	4th Heat.
1	2 01	0.86	0.84	0.88
2	0.93	0.65	0.61	0.62
3	0.94	0 51	0.56	0.50
5	0.90	0.62	0.67	0.66
6	1.03	0.67	0.66	0.72
7	3.47	0.85	0.89	0.83

By subtracting the second loss from the first we have the results in the first column below:

Sample No.	By Subtracting the Second Loss from the First.	By Heating in Nitrogen, Per Cent. Loss.
1	1.15	1.24
2	0.28	0.32
3	0.43	0.37
5	0 28	0.28
6	0.36	0.31
7	2.62	2.85

This is the only simple method we have tried which gives results that approach anywhere near those obtained by heating in nitrogen and hydrogen. The use of asbestos paper to make a close joint between the crucible and its lid is to be recommended where this method is used. The writers have tried placing a weighed sample of coke in a crucible and covering this with a weighed amount of freshly ignited sand. While the blank from burning does not run quite so high, it does not seem to be any more constant and the results do not seem to justify the extra weighing. It is possible that in a coke laboratory analyzing a fairly even product, a constant blank might be found and deduced, saving the extra heating and weighing.

The writers wish to acknowledge the valuable suggestions of Dr. P. W. Shimer, of Lafayette College, Easton, Pa.; and to thank for their kindness, Mr. W. H. Blauvelt, of the Semet Solvay Company, of Syracuse, N. Y.; and Mr. G. H. Caperton, of the Fire Creek Coal and Coke Company, West Virginia.

[From *Engineering*.—Continued from page 10.]

American Competition.—No. XIV.

[By Mr. G. W. Dickie, Manager Union Iron Works, San Francisco.]

Some time ago I was asked to contribute an article for publication in *Engineering* on American competition and its probable effect on English home and foreign markets; but after a careful study of the subject, and taking an inventory of all I could possibly write of what might be worth reading in regard thereto, it became evident to me that I was not in possession of any new facts, or any theories, in regard to the question of the effect that American competition might have on British industries, that would benefit the readers of *Engineering*. I was, therefore, obliged to decline.

On receiving a second request to contribute something on the subject, and having read the first of these articles, I thought that, after all, there might be something for one to say who considered this question from a distant standpoint; from that part of America that looks out on the Pacific, and that at present is watching for an opening of Asiatic markets that will give the Pacific Coast of America a great Trans-Pacific commerce.

I am somewhat in doubt as to whether there has been as yet any serious invasion of either the home or foreign markets that have been considered British by American manufactures. There have been times when the manufacturer of this country has been unable to sell the whole product of his factories at home, and has been forced to take the surplus to a foreign market, and there sell it for what it would bring, and this usually at a loss to himself; for as soon as the home demand equals his capacity, the foreign trade that he sacrificed so much to obtain is at once abandoned, and is never thought of again, until another surplus of products needs to be disposed of.

There are, it is true, certain lines of American products that have a steady market in Britain as well as in Continental countries. Thus, in engineering works there are special American tools, invented and perfected in this country, that are preferred to tools made elsewhere for the same purposes.

In the smaller class of machine tools, American makers have for many years been far in advance of British makers, both in design and diversity of function. This, I think, is conceded by British tool makers. But in very heavy machine tools for shaping large masses of steel, either into rough or accurate finished forms, the British tool maker is yet ahead of those in this country.

In the case of machine tools, price does not, as a rule, secure the sale; but adaptability to the work in hand, and quantity of accurate work turned out, with the least cost for operating. In these qualities the small American tools excel.

In large tools for heavy work having great rigidity, with large surfaces of great accuracy, producing large pieces finished true to form, the British tool maker still commands the best markets in the world for such types.

In steam engines of the highest class, and of the stationary type, some American forms, such as the Corliss engine in its varied applications, has established itself wherever steam is used economically; and some American builders have, from time to time, been able to export and install in British cities, in the very midst of famous engine builders, examples of American skill in engine building. But I doubt very much if this could be taken as an evidence that a high-class steam engine can be built more cheaply in America than in Great Britain. As has been pointed out in the fourth of these articles, the American excels in the manufacturing instinct; he manufactures in engineering, which the British engineer seldom does.

The American engine builder will adopt a certain type of engine, concentrate his own skill and that of his works on perfecting that type, and put it on the market, not a crude machine for other builders to improve upon, but as perfect as his skill can make it, rigidly tested, not only for economy, but also for durability, uniformity, speed, and other functions, combined with simplicity and attractive design.

This is at once the reason of the ability of the American manufacturer of machinery to compete with the British maker of machines, and also the reason why, in the production of original designs for special purposes, the British builder can more than hold his own against the American.

A good deal has been written in regard to the superiority of American workmen; but I think more is due to the manufacturing system than to the superiority of the workmen in this country. In fact, I believe the system of production in the United States aims at dispensing, as far as possible, with the necessity of skilled workmen. Every year we are finding it more and more difficult to obtain skilled workmen that can do general work in an engineering establishment; and in such branches of engineering as shipbuilding, and marine engine building, good workmen are harder to get here than they are in Great Britain. In fact, the majority of those employed in the shipbuilding trades in this country come from the British yards, and they can do no more here than they did at home.

We shipbuilders on the Pacific coast think that, given a free hand in design, we could produce ships as cheaply as those built in British yards; but if we build the ships as they do there, and pay more for material and more for labor than they do, our ships will cost more in proportion; where work—riveting, for instance—is done by piece, we cannot get men to do it at English prices. We are paying $4 per hundred for rivets that are driven in England for $2 37. We are driving rivets by pneumatic riveters at half the price for labor as for those driven by hand, but the British shipyards are now, or will very soon be, doing likewise.

In this business of shipbuilding, the American idea of manufacturing cannot be carried out to the extent that it is in other industries, unless some combination of building and owning were made possible, that would admit of a given number of types of vessels being designed to meet the varied needs of commerce, and then manufacturing them as required. This might help in the production of ships at a less cost than now; but with the large proportion of labor, skilled and unskilled, required in the building of ships, and its efficiency being practically the same in any two countries, the country that gets its labor

cheapest will build its ships cheapest, unless there is some other factor in production that balances the effect of wages.

Material is a large item in the building of ships and marine engines, and that is, perhaps, the most difficult quantity that the American shipbuilder has to deal with; and I doubt whether any prominent shipbuilding industry, of such magnitude as would be seriously felt by the British shipbuilder, can be established in this country, until the vast fluctuations that take place in the prices of materials cease to exist.

In the first of these articles on American competition, the author, Colonel E. A. Stevens, refers to what the shipbuilder can count on in regard to steel material. He says, an ironmaster known the world over, and thoroughly acquainted with American and English labor, lately remarked, in speaking of the prospect of successful American competition in shipbuilding: "I will contract to put down all the steel needed in an Atlantic coast shipyard at lower prices than it can be had in any British shipyard. If, with this advantage, and with American labor, you cannot beat the English shipbuilders, it will only be because you are not man enough to handle such an undertaking. It only needs the right man, and there are plenty of them in this country."

This sounded very well, and at the time it was said appeared to be true. The same ironmaster was then actually exporting steel material for shipbuilding, and selling it to British shipbuilders below the prices ruling in their own country. But what is the condition in regard to price of ship plates to day? This ironmaster who was ready but a few months ago, to deliver material to shipyards in this country at a price below that paid for like material in British yards, is asking to day for steel ship plates $69.66 per ton, the English price being $38.75.

As a proof that American steelmakers are not seeking foreign markets, we have only to note that these markets have no influence whatever on steel prices in this country. While the English price for steel ship plates advanced 12½ per cent. the American price for the same material advanced 120 per cent.

Any competition in shipbuilding that may arise between America and England will likely be the result of legislation in this country, to make it possible for an American shipowner to pay a higher price for his ship, and yet complete with the British shipowners.

The magnitude of the home market for all the products of industry in the United States will for many years prevent foreign markets influencing the price of materials that enter into the manufacture of articles that are made here for export, rendering competition possible only during a depressed condition of the home market. A high protective tariff fosters this condition, and will always make it uncertain how far it is possible to compete in foreign markets with those products where the cost of the materials is subject to great fluctuations, as compared with the material used by those with whom we compete.

Competition between the different sections of the United States is quite as complicated a question as between the United States and Great Britain. The vast extent of country between the two seaboards, the great distance of the western edge from the steel producing section, the difference in wages of from 30 to 40 per cent. between the Atlantic and Pacific coasts, makes the question of being able to compete with the East a problem of far more interest to us in California, than any dream we might at times have of competition with England in our line of business.

There will be certain kinds of work in which this country will excel other countries, and these products will command attention and sale in the markets of the world, and the number of these products and their volume will increase as their merits become better and more widely known. But I hardly think that English industries will suffer thereby; in fact, they will be stimulated. There are more British manufacturers to be met with now in this country than ever before, studying our methods, and eager to adopt anything that promises better results than they now obtain, and this intercourse will lead to improvement both here and there.

Several years ago British shipbuilders never thought of visiting the United States to learn anything in shipyard practice. But they come now to see us and what we are doing, even as far as the Pacific Coast. We are glad to meet them, and never fail to profit, if possible, by such visits, while there is no doubt that they also learn from us.

The competition so far, in my business of building ships, has been in skill rather than in price. It may be a long time before we can underbid the British shipbuilder; but for those that can afford our price, we can at least equal his best production in quality; and on these terms I hope the British shipyards may have all they can do, and that one particular yard on the far-off shore of the Pacific may never need to underbid them for a contract.

Apparatus for the Analysis of Illuminating and Fuel Gases.

By Mr. George E. Thomas, in *Jour. Am. Chem. Soc.*

There are many difficulties in the manipulation of the various forms of apparatus now employed for the analysis of illuminating and fuel gases. Much danger of loss is incurred in some methods of procedure incident to the repeated connecting and disconnecting of apparatus, while the size of others renders them inapplicable for easy transportation; also the necessity of frequent cleansing in some forms and the fragility of the material due to peculiarities of construction offer many obstacles in this line of chemical analysis. With these objectionable features in mind and with the desire to construct a piece of apparatus compact and efficient for technical work, the production of the form

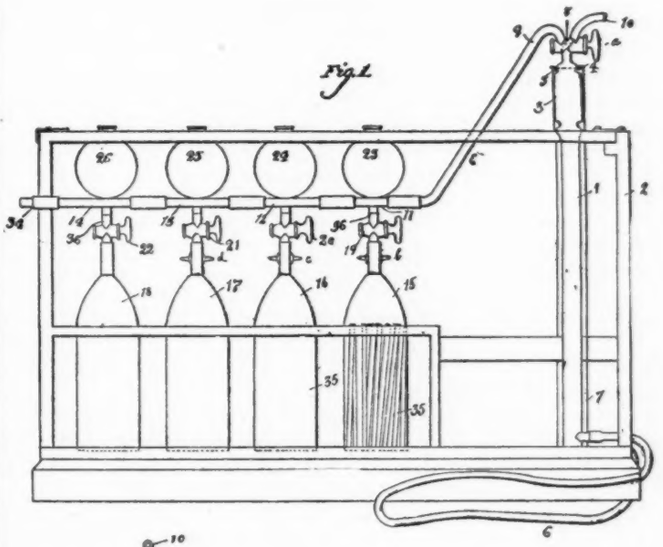


Fig. 1.

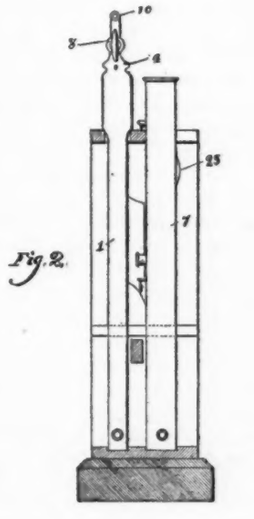


Fig. 2.

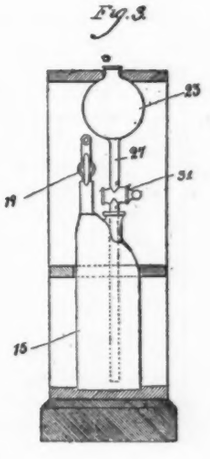


Fig. 3.

represented by figure 1 was undertaken, believing that there would be a demand for it.

The apparatus here described consists of a burette and leveling tube joined by rubber and capillary glass tubing with bottles, each of which is provided with a funnel. The dimensions are 16 inches long by 15 inches high. The burette is graduated to 100 cc., 40 in whole dimensions, represented by the bulb 3, and the remainder in fifths of the same and is supplied with platinum terminals 4 and 5, about one-half inch from the top; it is connected with the leveling tube 7 by rubber tubing and is filled with water acidulated with sulphuric acid to decrease the solubility of the carbon dioxide in the water. The burette is joined to the absorbing bottles 15, 16, and 17 and the storing bottle 18 by the capillary tube *e* and the capillary T tubes 11, 12, 13, and 14 having stop cocks 19, 20, 21, and 22 connected by rubber tubing; 14 is provided with a plug 34. The funnel tube of each bottle serves for the exit of liquid from below. Tubes 23, 24, and 25 are supplied with

stop-cocks *b*, *c*, and *d*, none being required on the last tube, as bottle 18 is used only for storing. Bottle 15 is filled with a solution of caustic potash; larger surface to increase the absorption is obtained by the use of glass tubes. Bottle 16 contains water saturated with bromine, while 17 holds the phosphorus covered with water, being protected from the action of the light by a black cloth. Bottle 18 is filled with water, as it is only used for storing gas.

Before beginning the analysis stopcocks *b*, *c* and *d* are opened. Upon opening the 3-way cock *a*, and raising the leveling tube 7, the burette is filled with water, also the capillary tube 10, which, after closing *a*, is connected with the gas supply. By lowering 7 and again opening *a*, gas is drawn into the burette; 100 cc. are measured after allowing the sides of the burette to drain. Communication is now opened between the burette and bottle 15, by means of stopcocks *a* and 19; raising 7 forces the gas through the capillary tubing into 15. This operation is repeated three times, always allowing the water in the burette just to enter the capillary system finally bringing the solution to the mark; 19 is now closed, and the water in the burette and tube 7 is brought to the same level before closing *a*. After draining, the loss in volume is observed. The same process is carried out substantially as described for the absorption of the illuminants and oxygen by bromine and phosphorus in bottles 16 and 17 respectively, precaution being taken to completely absorb the bromine vapors in the gas after the elimination of the illuminants, by potassium hydroxide in bottle 15 and allowing the fumes to almost disappear after the absorptian of the oxygen before returning the gas to the burette. Thus the carbon dioxide illuminants and oxygen are determined, after which the remainder of the gas is stored in bottle 18 prior to exploding portions with air, or air and oxygen. These direct absorptions are followed by the introduction of about 80 cc. of air into the burette through the tube 10. This is collected before the gas because of the coarser graduation in the bulb, very accurate measurement being required in this operation. By opening *a* and stopcock 22 and lowering 7, about 15 cc. of gas are drawn into the burette. Now 22 is closed and 21 opened, thereby filling the capillary tubing to 8 with water from 17 to insure an accurate determination. Now close *a*. After draining, make a reading of the volume, and after opening communication at *a* and 19 pass the gas and air into 15 to obtain a thorough mixing, after which it is returned to the burette, the solution being brought to the mark; 19 is closed and the tubing filled as before with water from 17. Close *a* and lower 7 to reduce the pressure. Clamp or preferably bend the rubber tubing and introduce into a slit in the side of the frame, thereby obtaining a perfect water seal, allowing no opportunities for loss when the mixture of gas and air is exploded.

Contact is now made between the platinum terminals and an induction coil attached to a battery, a spark produced therefrom igniting the the mixture. A flame is seen suddenly to run down the burette, the explosion being very mild, due to the peculiarity in construction of the burette, carbon dioxide and water being the products of combustion. The gas is now allowed to assume the temperature of the room after the pressure on the tube is released. The contraction is observed, also the amount of carbon dioxide produced by absorption in 15, and the excess of oxygen in 17, the same precautions as to filling the system with water after each determination being strictly adhered to, together with the suggestion that the last time the gas is passed into 17 for the separation of the oxygen, that water from the burette be forced through the capillary system into 17 to insure complete absorption.

From the data thus obtained, it is possible to calculate the amount of hydrogen, carbon monoxide, and methane by following the well-known formulas in Sutton's "Volumetric Analysis:"

(1)

$C = 1\frac{1}{2}x + \frac{1}{2}y + 2z$ $x = A - D$ C = Contraction

$A = x + y + z$ $y = \frac{3A - 2C + D}{3}$ A = $a - n$ = Vol. of gas—n

$D = y + z$ $z = \frac{2C - 3A + 2D}{3}$ y = Carbon monoxide

z = Methane

x = Hydrogen

D = Carbon dioxide

n = Nitrogen

(2)

$B = \frac{1}{2}x + \frac{1}{2}y + 2z$ B = Oxygen consumed

$x = A - D$ A = $a - n$ = Volume of gas—n

$y = \frac{3D - 2B + A}{3}$ n = Nitrogen

$z = \frac{2B - A}{3}$ D = Carbon dioxide

As the excess of oxygen after the combustion is absorbed by phosphorus in bottle 17 an explosion with hydrogen is avoided. What remains after this process is completed is the nitrogen in the air plus the nitrogen in the gas; a direct determination of the latter is thus made possible.

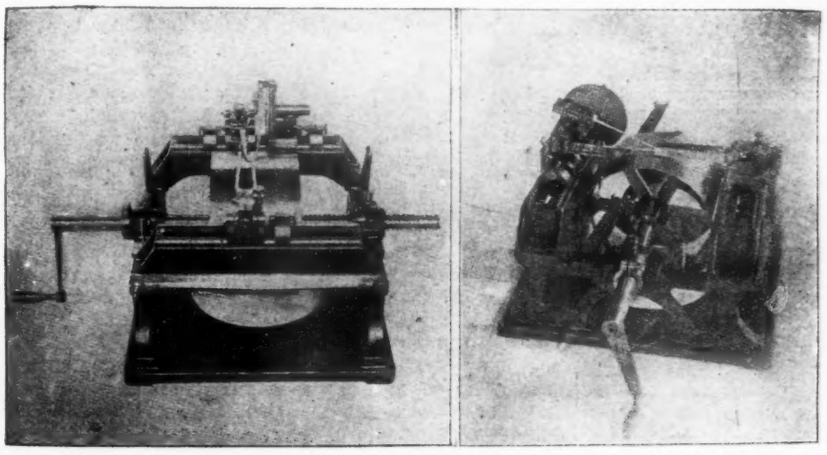
If it should be desired to employ this apparatus for fuel gas analysis, bottles 17 and 18 can be filled with a cuprous chloride solution, using a layer of petroleum in the funnels to prevent the air having an oxidizing action upon the copper solutions. By the use of two solutions a more accurate determination is made, as it is well known that one cuprous chloride solution repeatedly used is not a satisfactory regent for the absorption of carbon monoxide. It has been found that a lubricant is absolutely essential for success with this as with similar forms of apparatus. A uniform temperature should be maintained in the laboratory as the burette is not water-jacketed. The apparatus described appears to have many advantageous features beside its compactness, which is certainly desirable, for ample space is allowed above the funnels for an induction coil and small battery, making the complete outfit to go in a case 16 by 17 inches. The T-tubes being separate and 36 having a plug, 34 affords opportunity for rapid and easy cleansing of the capillary system. After the gas is once collected, there is no possibility of loss as it remains in the apparatus until the analysis is complete, and, if necessary, several confirmatory explosions are made. All the parts are readily disconnected and sections when broken can be easily replaced. With the exception of 17, disconnection is only required in case of accident, as the other bottles may be replenished by forcing the liquids into the funnels, siphoning off and fresh solutions added. Direct explosion in the measuring burette is an advantage as it eliminates the necessity of an extra bottle for that purpose. Less than an hour is required for the completion of an analysis by this method and the results obtained have been eminently satisfactory.

The Location of Pipe Obstructions by Sound.

Engineering Record says that the pneumatic despatch tube for the delivery of mail between the main Philadelphia post office and a branch office at Chestnut and Third Streets is a cast iron pipe, about 6-inches in diameter and 3,000 feet long. This pipe is buried below the surface of the street, and in it small cylindrical carriers, 6-inches in diameter, are propelled from end to end by air pressure. At one time a carrier became lodged at some unknown point in the tube, and to remove the obstruction it was desirable to locate its position as closely as possible before digging down to the pipe This was satisfactorily accomplished by firing a pistol at one end of the tube; its report was echoed from the obstruction and indicated its position by the time required for the transmission of the sound. The methods employed are of interest as a practical application of scientific principles which may be found useful for use in inaccessible pipes or conduits of other systems.

The pistol was fired in a hole in the side of the pneumatic tube near the end, which was capped and had a rubber hose connection to the recording apparatus. The end of the rubber hose terminated in a chamber closed by a diaphragm about 5 inches in diameter, which had a stylus attached to it. A cock in the middle of the rubber hose was partly closed to reduce the force of the explosion on the diaphragm, and the pistol was fired. The sound wave immediately produced a movement of the diaphragm, causing the stylus to make a mark on the record diagram. The hose cock was then fully opened, and when the sound wave had traveled to the obstruction and been reflected back, it again moved the diaphragm and caused the stylus to make a second mark on the diagram. The lapse of time had been automatically recorded on the same diagram, so to determine the distance it was only necessary to note the exact interval of time between the direct and reflected reports, divide it by two and multiply the quotient by the velocity of sound under the existing conditions.

A drum was improvised from an ordinary 12 inch iron belt pulley with a 6 inch face, which was mounted on a horizontal threaded shaft whose bearings were tapped to correspond, so that when it was revolved it received a longitudinal motion and a fixed point would trace a spiral line on its smoked surface. A clock pendulum was made to swing through mercury and close an electric circuit every second, which caused an electromagnet to make a mark on the drum with a stylus. A tuning fork was set just above the drum, with a vertical horse hair cemented to one of its prongs in such a manner that it just touched the cylindrical surface. The pendulum was set in motion, the tuning fork was sounded, and the drum was revolved by a hand crank. The pendulum stylus traced on the drum a spiral line in which a right angled



Apparatus for Locating Pipe Obstructions.

offset, parallel to the axis, was made every second by the action of the electromagnet. The tuning fork traced a zigzag line, which was described about a spiral parallel and adjacent to that of the pendulum record, and practically divided each unit of the latter into 1.024 parts, two for each complete vibration of the fork. The marks made by the diaphragm stylus parallel to the axis of the cylinder intersected the record diagram so that it was only necessary to count the full second marks included, and the tuning fork vibrations for the fractions of a second at each end, to determine the exact time between the firing of the pistol and the arrival of its echo.

Five observations were made with a maximum variation of only 0.0003 of a second, and their mean was 2.793 seconds. It was assumed that the temperature of air in the tube was 39° and the corresponding velocity of the sound was calculated to be 1,101 feet per second. Consequently the total distance traveled by the reflected wave was 3,075 feet and the obstruction was 1,537 feet from the instrument. Excavations were made at this place and the carrier was found nearly at the calculated point.

A great advantage of this method is that it can be made to give accurate results with simple apparatus easily fitted up from common instruments, and that its precision is independent of the speed or even of the regularity of the rotation of the drum, the register being made automatically and with constant standards which can be tested or verified at any time before or after the experiment. The apparatus was devised and the measurements made with it by Mr. B. C. Batcheller, the engineer of the Batcheller Pneumatic Tube Company, who has since constructed a complete instrument on the same principle, in which the different parts are mounted adjustably on an iron frame with screw bearings for the drum shaft and a sliding bed on which the tuning fork and electromagnet can be clamped in any position. The vertical adjustment of the fork and needle is provided for by set screws. The sound receiving diaphragm and stylus lever are mounted on the back bed. Mr. Batcheller states that the limits of distance within which this method is practicable have not yet been established, but the sound waves from a pistol shot will vibrate a sensitive diaphragm at distances of 13,635, 37,500, and 65,129 feet respectively when transmitted through tubes of 0.7, 11.8 and 43.3 inches diameter.

Electrical Development as Portrayed in the National Museum.

By Mr. A. F. Tennille, in *Electricity*.

To a lover of technique in general and of electrical appliances in particular it would be hard to find a more congenial spot than the National Museum at Washington, D. C., in which to spend a pleasant afternoon. Not only would he call to mind the names that have aided in bringing electricity up to its present high state of development, but he would find spread out before his inquiring gaze models dating from the first crude conceptions of a dawning innovation down to the varied adaptation of to day, and yet he would be tempted to turn away dissatisfied and feel that this was only the beginning of greater things yet to come.

From the first inception of the Museum much attention has been given to electricity ; a magnetic telegraph is mentioned as far back as 1848 ; in 1853 an electro-magnetic observatory was authorized to be erected on the Smithsonian grounds, by the Board of Regents, and was carried on until 1860 when it was discontinued and the instruments taken to Fort Taylor, Key West. During its earlier history astronomical work was carried on under the auspices of the Museum, and in 1873 the ocean cable and inland telegraph companies extended to it the privilege of free transmission of messages over their wires for all astronomical work connected with this branch. Early in December, 1873, that was also transferred, the Signal Office of the War Department being its later home. The present building is equipped with telephone and electric lighting apparatus. So much for the building with which every Washington visitor is familiar ; with the electrical display contained within its walls, however, it is safe to say that very few people are at all familiar.

The electrical division is under the general charge of J. E. Watkins, curator, and under the more particular charge of Mr. George C. Maynard, as custodian of the electrical collections, and to whom much that is of interest in the present article is largely due. The prospects for building up an interesting series of historical electrical apparatus are claimed by the Museum authorities to be very gratifying, and substantial progress in that direction has already been made. Exhibits are made of electrical engineering, including telegraph systems and apparatus, telephone systems, lighting, heating and other apparatus, together with motors, stationary and for traction purposes. The electrical collections have recently been increased by specimens connected with Prof. Henry's discoveries in electro-magnetism, and by some instruments that had heretofore been in the Smithsonian Institute.

The number of electrical exhibits at the present time is about 400 and more are constantly being added. At the close of the Atlanta Exposition two new cases were erected in the east hall of the building in which were deposited the collection relating to electrical industries.

In giving the following brief outline of the exhibits many names and events almost forgotten will be brought to mind, each replete with interesting associations. As far as practicable exhibits have been arranged as are the chapters of a book, so that they follow the natural law of succession. Examples are shown of lighting arrangements extending from the old stone oil lamp of the Indian and Eskimo to the candlesticks, lamps and lanterns of our grandfathers, down to and including the introduction and progression of electric lighting, which is shown in a complete exhibit of incandescent globes, extending from 1860 to the very latest models In the exhibit are two original incandescent lamps made and used by Farmer in his experimental work in Newport, R I., one of which stands about 10 inches high on an ebony base. The lamps range in size from 100 c.p., to the smallest commercial sizes ; and in this collection is one of the earliest tin shades in connection with a cumbersome lamp, socket, and fixtures that the electrician of to-day would be tempted to throw out on the dump ; another item in this case is two plugs that were put into the lighting system in 1881 ; prior to that date no safety plugs were used on any branch lines to lamps, the practice being that of soldering a small section of lead wire into the trunk lines. Several Hinds curiosities are also to be seen in this case, among them is a photograph of an Edison Z dynamo, made in 1881, and used by Hinds, Ketches & Co., at their establishment, 449 Water street, New York ; another item is the original switch key with which the current was turned on the lamps in Hinds' factory, on the evening of January 15, 1881 ; and another brought into service with the second dynamo introduced by them in November of the same year ; the original resistance coil attached to the first dynamo used in the Hinds' factory is shown, this was used for a short time but was soon replaced by an adjustable resistance box.

The General Electric Company is represented in the same case by a series of porcelain bases and of insulated wire to carry heavy currents. An original trolley wheel used in connection with Stephen D. Field's experimental electric railway in 1881, and a complete Edison phonograph of the spectacle type, in all its beauty and completeness, tend to add attraction to the display.

Prof. Joseph Henry, of whom mention has already been made, was Secretary of the Smithsonian Institute from 1846 to 1864, and during that time he made many valuable experiments. "Despise not the day of small things" might be aptly quoted in this connection, when you look at the very magnificent factor to the practical development brought about by Henry, this factor being a time worn book, entitled "Lectures of Experimental Philosphy, Astronomy, and Chemistry by G. Gregory," in two volumes, published in 1808; the first volume only is shown, but it is accompanied by an autograph letter in which Henry states that this book, which he read for the first time when he was sixteen years of age, was the first scientific book he had ever read; and to the influence of which he owned all of his later inventions. As if to show a peculiar sequence of cause and effect, in juxtaposition to this little volume are placed some of the magnificent medals of which he was the recipient, including one from King Carl of Sweden, accompanied by an autograph letter setting forth in a few well chosen words his acknowledgment of what the world and Sweden owned by Henry.

In view of the fact that so much controversy has arisen during the past few months as to the originality, patentability, and other features of wireless telegraphy as set forth by Marconi, the United States Government, and others, it may not be without interest to state that as long ago as 1842 Henry had actually demonstrated the practicability of such an idea, in witness of which can be seen the three original induction coils by means of which the experiments were carried on in his home at Princeton. These experiments were not made to demonstrate a commercial but a philosophical conclusion. The induction theory was, that if two wires run parallel to each other and unconnected, the one cannot be charged by electricity without the other becoming similarly charged. Prof. Henry argued that this could be done at long range, so gradually lengthening the distance of the disks he increased the range inch by inch, foot by foot, floor by floor, until finally the upper disk was in the third story and the lower one in the basement of his home, and the induction was still perfect. The disks were covered with tinfoil; the upper one was charged by a machine, and the lower one was arranged so as to prevent the electricity from escaping to the ground. If, when in this condition a knuckle was held near the lower disk, and the upper one was charged by a spark received on a ball attached to the end of a wire connected with the earth, a spark was seen to pass between the knuckle and the lower disk.

Henry carried on experiments from 1829 to 1842 for the purpose of fully investigating the laws of electro-magnetism.

In the same case with the disks above mentioned is the second of two large electro-magnets devised and constructed by Henry and made in Albany, N. Y., in 1831, for use in the laboratory of Yale University. It remained there until 1893, when it was presented to the National Museum. It will suspend a weight of 2,000 pounds or more. The magnet itself, exclusive of the copper wire surrounding it, weighs 59½ pounds, and was constructed from a bar of Swedish iron 3 inches square and 30 inches long. The perpendicular height of the horseshoe is 11¾ inches; round distance from one pole to the other 29 $\frac{5}{16}$ inches; inside distance from pole to pole 3½ inches. The armature or lifter was formed from the same bar of iron, is 3 inches square and 9½ inches long, and weighs 23 pounds. The magnet is suspended by means of a piece of round iron attached to the cross beam of its framework, with an eye in its end. The magnet is wound with twenty-six strands of copper wire, covered with cotton thread 31 feet long. Eighteen inches were left projecting at each end, so that only about 18 feet actually surrounded the iron. The aggregate length of the coils is 728 feet, and it was so wrapped that there were three thicknesses in the center, increasing to six or eight on the ends.

A curious item of the Henry collection is a portable electrical apparatus small enough to be contained in a case resembling a gentleman's pocket cigar case, which was used by the so-called spiritual mediums to produce spirit rappings, and which was detected by Prof. Henry. A rude model of an apparatus constructed in 1831 to demonstrate electro-magnetism, and a more advanced instrument used for the same purpose during his connection with the Smithsonian Museum, are some of the items which go to make up this interesting collection.

Another curious relic is a contrivance about 2 feet square, containing an iron diaphragm $\frac{3}{16}$ inch in thickness, weighing 25 pounds, and encased in a wooden box border 3 inches wide, used by Prof. Alexander Graham Bell in his earlier telephone experiments, and a note attached to the model says that it was "a good, practicable telephonic transmitter."

In with the bell collection of telephonic apparatus is a Reis telephone transmitter, invented by Philip Reis, of Frankfort, Germany, in 1860. Another curiosity of this collection are three telephones, in beautifully carved ivory cases, although they are becoming discolored by time, having been made for the use of Queen Victoria, when the telephone was first introduced into England. A further survey of the multitudinous Bell items discloses the first induction balance made by him, another made by him and used on July 26, 1882, to find the bullet in the body of the late President Garfield, and a second and more powerful one used for the same purpose on August 1, 1881; inductor balances introduced during that year in various hospitals in the United States, England and France for similar purposes; a telephonic probe invented in the same year; an inductor balance audiometer for making tests in aural difficulties, and exhibited at the Royal Commission, London, England, June 26, 1888.

A number of exhibits appear showing different instruments invented by Bell in the endeavor to perfect photophones; the first model made in 1879, and another in 1880. By means of this instrument it was intended to reproduce sound or articulate speech by a beam of light, and with the instrument made in 1880, together with a selenium receiver, also on exhibition, articulate speech was transmitted by means of a beam of light a distance of 213 meters from the Franklin School to Prof. Bell's residence at 1325 L street, in Washington.

Not the least interesting of this collection are the Morse models and included in it are two models, one original and one duplicate and half-size, of the first electro magnetic telegraph instrument used by Morse. In its construction he employed an old picture frame which he fastened to a table; the paper was carried forward by means of clock wheels connected together with a small chain. This was made in 1837.

The lead type used by him in his first telegraphic apparatus for opening and closing the circuit mechanically is also displayed. There is a curious telegraphic register said to have been made and used by Morse on a private line in 1837, for the purpose of keeping up communication with the Rev. Henry Schief, of Baltimore; a register used in Toledo in 1850, another made for him by Knox & Shain in 1857; and thus down through the long list to that most perfect of instruments used in New York city, in May, 1896, at the Electrical Exposition, upon which Chauncey M. Depew's famous message was sent around the world.

A drawing in a well-preserved pocket sketch book shows Morse's first conception of the electro-magnetic telegraphic instrument. Original instruments are shown used by him in 1843, 1844 and 1845. A piece of an original telegraph wire that connected Washington with Baltimore in 1844; a pocket telegraph instrument introduced in 1860 and much used at that time; a galvanometer brought by Morse from London and presented by him to H. A. Reed, an operator at Poughkeepsie, N. Y., and used in testing telegraphic lines in 1865, are other interesting items of this exhibit; in addition to which appear models of an original Morse telegraph key in use from 1843 to 1891; a Morse telegraphic sounder made by J. J. Clarke, of Philadelphia, in 1856; telegraphic relays from 1860 to 1891, and an original experimental telegraphic apparatus.

An interesting addition to the collection is that made by the Coe Brass Manufacturing Company, including a one-arc electric lighting machine, known as the Wallace-Farmer machine, and made by William Wallace in 1876 and exhibited at the Centennial in that year; what is supposed to be the first gramme armature wound electric light machine in this country, manufactured by Wallace in 1873, and which is generally conceded to be the first machine ever run on that principle. It was the first dynamo constructed and operated practically in the United States, and was exhibited at the Franklin Institute Fair in 1874. Another item of this exhibit is the first electric plating machine, made by William Wallace in 1875; it combined a Wallace field with a Farmer armature; this also was exhibited at the Centennial. The last important item of this exhibit is the electric light machine manufactured by Wallace in 1875. It furnished the current for the arc lights in the Machinery Hall during the entire time of the Centennial.

The Moses G. Farmer collection consists of more than fifty models. One of these is an electric motor and car made by Mr. Farmer in 1847, and used by him when lecturing upon electricity; it moved on rails placed around the inside of the lecture hall; had two cushioned seats, in which he used to place his children during practical demonstrations of its abilities. The electrical apparatus consisted of a circuit on which were placed 24 armatures, all of which were charged from 6 field mag-

ns; the battery was connected up on the left side. Car and motor were each about 6 feet long.

Several models of Wallace arc lamps are shown; transmitters for use in submarine telegraphy; keyboards for testing and firing torpedoes, used in the United States Navy in 1870; a model of a storage battery plant, devised and made by Farmer; incandescent lighting; and an old dynamo devised by Farmer and used by him at Newport. And to show that there was a practical as well as an inventive side to his nature (a combination not always apparent), we have only to look at a meat broiler operated by electricity, made and used by him prior to 1850.

The Cyrus W. Field collections are very complete, and this fact is largely due to a number of different objects presented to the Museum by Mrs. Isabella Field Judson, including items connected with the various Atlantic cable ventures, together with autographic charts and records of his first cable enterprises. Included in this collection is a very handsome sub-collection of submarine telegraph cables, manufactured by Glass, Elliot & Co., of London, England, between the years of 1854 and 1863, including end samples of each cable, together with the names of the countries for whom they were made, and the date of their manufacture. This collection was a present from the manufacturers to Mr. Field. There is a piece of the first trans Atlantic cable connecting Ireland with Newfoundland laid in 1857; the sample is taken from the land end in Newfoundland, and all messages sent over that route were received through its medium.

A section of telephone cable composed of 241 copper wires, No. 19 B. & S. gauge, insulated with paper, and arranged in pairs for metallic circuits. A piece of the deep sea portion of the first Atlantic cable. Another object of interest is the original signal buoy used in connection with the first electric fire alarm system installed in Boston, on April 28, 1852, the first alarm was sent in the following day. A specimen of the submarine cable of 1866, manufactured by W. T. Henley, of London, intended for use in the Behring Sea portion of the Russo American telegraphic lines, which were commenced but abandoned upon the successful laying of the Atlantic cable in that year, and never since that time attempted. Specimens of the Atlantic cables of 1858. 1865, and 1866; a model of the grapnel and a piece of the original grapnel rope used in the recovery of the Atlantic cable in 1865.

Among the other scattered items of interest must not be overlooked an automatic telegraph repeater, made by Milliken and first used in Portland, Me., in 1862 in connection with the lines of the American Telegraphic Company, running between Boston, Mass., and Calais, Me.

The exhibit of insulators contains those of Brooks, Wade and House. There is a series of 7 sections of the Atlantic telegraph cable, from the deep sea to the shore end; also a model of a Davenport electric motor and railway made in 1887.

An item of more than passing interest is the first electric welding machine ever used, invented and brought into operation by Prof. Elihu Thomson, in connection with the first trials of his electric welding process in 1886. His discoveries with this model form the basis of the electrical welding industry of to-day.

The first regulator used in connection with Thomson-Houston arc light dynamos is there, also the first arc light dynamo equipped with spherical armature, made by Prof. Thomson in 1879.

Contributions to the electrical part of the Museum have been received from the Western Union Telegraph Company, the Telegraphic Historical Society and others, one of which is an electric motor that was operated by a current generated at Niagara Falls and transmitted to New York City over the commercial wires of the Western Union. Many men have helped, both by information and research, among them being Gen. Thos. T. Eckert, president of the Western Union Telegraph Company, Messrs. C. A. Tinker and A. S. Brown of the same company, Edward L. Morse, Dr. Henry M. Field, F. C. Martin and S. H. Kauffmann.

It is the intention, as soon as practicable, to inaugurate a more perfect classification and arrangement of the collection, and to add the gradual establishment of a complete collection of historical apparatus showing the development of the art of generating electricity and its application to the various sciences and industrial purposes, and the preparation of a series of models of epoch making apparatus, illustrating the more important discoveries in electrical science, commencing with the voltaic pile and continuing down to the intensity magnet of Henry.

We understand that the New England Gas and Coke Company has commenced to supply gas to the Dorchester and Charlestown Gas Companies.

Storage Batteries and Isolated Plants.

[By Mr. Alton D. Adams, in *Electrical World*]

The Electrician, of London, dated Oct. 20, 1899, contains an editorial from which the following is a quotation: "If, taking account of interest, depreciation and cost of attendance on a storage battery, it is economical to level a consumer's load by this means, the same would apply to the station itself." The editorial then goes on to state "that it does not pay a public supply station to include in its equipment a storage battery large enough to level the highest peaks of the load curve." This matter was written in criticism of an article by the present writer in *Cassier's Magazine* for October, 1899.

The article in question was intended to show that with very low rates for central-station service, at certain hours of the day, when the public demand is least, it may be more to the advantage of a consumer to put in a storage battery and charge with the cheap central-station supply, than to put in engines, boilers and dynamos for an isolated plant. One conclusion reached was that where exhaust steam cannot be used for heating, the low rates made by some stations for supply, taken at certain times of day, make the battery more desirable for a consumer than a complete generating equipment.

Whatever may be the exact meaning of the words quoted from the above-named editorial, the hard fact remains that a condition and not a theory engages our attention. The average charge for electric energy from central-station supply is a certain amount in any particular case, being about 10.6 cents per kw-hour for the one cited. The cost to large consumers of electric energy from their isolated plants commonly varies from 3 to 6 cents per kw-hour, much depending on the amount of exhaust steam that can be used and on the labor required by the isolated plant beyond what would otherwise be necessary. Public supply stations, during some hours of the day and night, when the demands on them are least, are glad to sell electric energy at a fraction of their regular average charge, a rate as low as 3 cents per kw-hour having been made, by the station cited in above article, for service at times of the lightest loads.

In some private establishments that would otherwise use an isolated generating equipment, it can be shown that the storage battery, when charged at the lowest public rates, will give the cheapest service, because exhaust steam cannot be used to advantage, and much of the help necessary for the generating plant would not otherwise be wanted. The management of a private concern under these circumstances will not stop to ask whether it would pay the public station to put in batteries there and charge him a rate that he will not pay for energy, but will install the batteries instead of the isolated generating equipment, and take advantage of the low rate during hours of small public demand.

For example, take the case of an office building, where conditions are such that the cost of energy generated by an isolated plant of boilers, engines and dynamos is 5 cents per kw-hour, and let the demand for this energy occur in large part between the hours of 4 and 10 P. M., as is commonly the case, when the public supply is most heavily loaded. The central station will supply electric energy to this building during the times it is wanted at, say, 10 cents per kw-hour, because the capacity of the station equipment in boilers, engines and dynamos or in batteries must be increased to correspond with the highest kilowatt output during the hours of maximum load. Leaving the batteries out of the question for the moment, the owners of the building just considered will probably elect, as thousands of others have done, to install an isolated plant and generate the required electric energy at a cost of 5 cents per kw-hour, rather than to pay the public supply rate of 10 cents per kw hour.

The argument of the above editorial, if extended to the isolated plant, would seem to be, that because the central station cannot afford to put in the additional boilers, engines and dynamos to supply this building at the time of maximum load, for less than its regular charge of 10 cents per kw-hour; therefore, the building owners can hope to gain nothing over public supply rates at 10 cents, even though it is certain that the total cost of energy from the isolated plant will only be 5 cents per kw-hour.

That this argument is not appreciated by large users of electric energy, is shown by the thousands of large isolated plants that dot the areas of public central-station service. Assume now, as is actually the case in some instances, that the public supply rate during certain hours of the day and night is only 3 cents per kw-hour for energy taken exclusively at those times, in large quantities. The building owners, by the use of a storage battery, can buy the energy necessary for each day during those times when the price of public supply is least, and thus

secure their electric service at a lower cost than that at which it can be generated in the isolated plant. Allowing an efficiency of 85 per cent. for the battery on an average, the actual cost to the building of electric supply will be 3÷85=2.53 cents per kw-hour, exclusive of interest, depreciation and care of the batteries.

Without going into the actual first cost of engines, boilers and dynamos for an isolated plant and that of batteries for the same maximum rate of work, it may be said without fear of error that the difference of interest charges on the two equipments would be a very small per cent. of the yearly cost of current in any case. The care of batteries is trifling in expense compared with the operation of an isolated plant of boilers, engines and dynamos, and could often be intrusted to the janitor of a building, under the direction of the central station or that of a consulting engineer. Battery depreciation and repairs for the kind of service now considered are easily held within 10 per cent. per year on first cost, the makers being usually willing to maintain them at this figure. If the cost of 3.53 cents per kw-hour above found for energy alone be increased to 4 cents in order to cover attendance, interest and maintenance, the allowance will be ample. At a cost of 5 cents for energy developed by an isolated electric plant, per kilowatt hour, the annual outlay is 25 per cent. greater for the same service than with the battery on the above showing.

It by no means follows from the above conclusions, however, that were the batteries necessary to operate the maximum load at the building installed at the central station, the station management could or would supply the building at the rate of 4 cents per kw-hour during periods of maximum load. Neither is it true that it would pay the central station to operate a large part of its maximum load with storage batteries there, simply because a saving is made by the building owners in the above case.

The conditions of public demand for electrical supply are such as to create an advantageous opportunity for those who are able to receive their necessary daily amount of electric energy during those hours when the great majority of consumers cannot. The storage battery enables a consumer to avail himself of this opportunity. Since the maximum load of a public supply station usually continues for two or three hours per day, and during a large part of the twenty-four hours the demands of consumers are very light, a large part of the generating machinery is idle for a large part of the time. Any load that the central station can secure beyond the small normal amount, during the periods of minimum public demand, is evidently a clear gain by any amount that the selling price exceeds the actual cost of production, as to operating expenses, all fixed charges being neglected. Now the fixed charges for a station with an expensive distribution system are a large item in the total cost of operation, so that service which requires no increase of investment may well be rendered at a large reduction from the normal rate.

Apart from the relative advantage between the private consumer and the public supply company, there is a decided and positive advantage in the location of the battery on the premises of the consumer rather than at the generating station. This advantage arises from the lower first cost, higher operative efficiency and superior service that obtains for the conductors between the generating station and the point of use when the battery is located at that point. The cost of the distribution system is usually a large per cent. of that for an entire central-station equipment. Figures for one of the largest Edison systems in the United States show the cost of electric lines to be the largest single item of investment and larger than all others combined, outside of real estate. For another public plant in a city of moderate size the investment in electric lines exceeds that of all other kinds.

In the design of a system of electrical distribution it is, of course, necessary to weigh the disadvantages of a high per cent. of loss in conductors and unsatisfactory regulation of pressure, against a large first cost for copper. Whatever the size of conductors selected, they must be proportioned with special view to the conditions at maximum load, since the per cent. of loss and the troubles incident to lack of pressure regulation are then the greatest. For a given per cent. of loss, the larger the maximum load the heavier must be the distribution system, or with a certain system of conductors, the larger must be the loss.

The efficiency of a system of electrical conductors depends not only on the total amount of energy that they transmit per day, but also on the distribution of the energy as to time. The per cent. of loss in a given system of conductors that transmit electric energy at constant pressure varies directly with the amperes flowing at any time. Suppose that a certain set of conductors will transmit a given amount of energy per day, at a uniform rate during the twenty-four hours, with a loss of 4 per cent. If, now, this same amount of energy must be transmitted over the same conductors in three hours, or eight times as fast, the per cent. of loss will be eight times as great or 32 per cent.

The location of a battery at the generating station may, if the battery is large enough, enable the station machinery to be operated almost constantly at its maximum output, but this position of the battery can alter neither the per cent. of loss at maximum delivery of energy through the conductors, nor any variation of pressure arising therefrom, on the consumer's premises. This consideration tends to materially limit the capacity of batteries that may profitably be employed at generating stations.

When the battery is shifted to the premises of the consumer, his supply of energy can be delivered at times of minimum, instead of, largely, at times of maximum loss on the transmission lines, and the investment in conductors, so far as that consumer is concerned, is much less than would be necessary with the same battery at the station. Unless a very large reduction is made in the size of conductors, compared with those used with the battery at the generating station, the transmission loss will be less when the batteries are located at the point of service. With batteries located entirely at the generating station the problem of accurate pressure regulation on the service to distant consumers at maximum load is a serious one and cannot be solved with entire success. When the batteries are at the point of service, however, the regulation at their terminals is very nearly perfect.

So great is the advantage of batteries at or near the points where electric energy is delivered to the consumer, that public supply companies, working on the direct current, low pressure system, now locate by far the greater part of their batteries at distant locations in their distribution system, instead of at the generating station. These battery substations are clearly an additional investment, at least for the real estate, over batteries at the generating plant, but the increased economy of operation, the lower outlay for conductors and the superior regulation of the pressure at consumer's premises more than offset the expense of substations, as is shown by their extending use. Batteries at substations are charged at times when the demands on public supply are small and discharged at times of maximum load, also at some times of minimum load, when the generating machinery is not in use. The main generating station, of course, operates in multiple with the batteries at substations at times of minimum load, and the per cent. of the maximum output carried by the batteries will vary in different plants.

The ampere output curve for a very large generating station, now before the writer, shows an average load during the entire twenty-four hours of about 70 per cent. of the maximum load, in spite of the fact that the output curve for the system to which this station belongs has a maximum of more than twice its average. The generating station just named supplies all of the energy for a very large, low-pressure direct current system, feeding several battery substations and also directly into the service mains.

A large private battery plant is virtually a substation, with this in its favor, that its load is very close at hand. The great majority of consumers are not in position to install a private battery because of their small requirements, or from other reasons, and the unequal distribution, as to time, of demands on the public supply seems likely to continue. With the present requirements for public electric service, central and substations must continue to carry a combined capacity of generators and batteries much greater than that necessary for average, to say nothing of minimum loads. Until the usual proportion of generator capacity to total output is much less than at present, central stations can well afford to offer rates to large users, at times of minimum load, than warrant private investment in heavy batteries.

The Otto Coke Oven in Germany.[1]

In the coke ovens, with apparatus for the saving of bye-products, which have been built recently, the new Otto oven has enjoyed an unusual preference. Since it was first intoduced—three years ago—690 ovens have been erected; and out of the 642 in course of erection, 462 are of this type. Besides, last year 50 of these ovens were built in England. Of the 702 recovery ovens built in 1896, 340 are furnished with the Otto-Hoffman apparatus for heating the air. The advantages of the new oven are briefly as follows: (1) Greater durability. (2) Diminished length of gas and air flues. (3) Development of the flame upwards. (4) Uniform heating of the whole oven. (5) The possibility of inspecting every portion of the walls, and of regulating the heat as may be required, while at the same time a more perfect combustion of

1. *Iron and Coal Trades Review.*

the gases is effected in the flues. (6) Satisfactory yield and quality of the coke and bye-products. (7) Large production of steam.

When, in the year 1881, Dr. C. Otto began to construct coke ovens with bye-product plants, he selected for improvement the Coppée oven. In this system the oven is situated above three main flues communicating with the vertical flues in the walls. In adapting this to the saving of bye products, gas and air were admitted into the horizontal main flues, and thence into the vertical flues, and then flowed back again. It is at once evident that it is not possible to develop such a flame underneath a number of vertical flues that throughout every part its heat is equally powerful. If the flame be represented in a diagrammatic form we shall obtain a curve beginning at the entrance of the gas, increasing as far as the center, and then diminishing. This line shows that the heating of the wall of the oven is not uniform throughout. To obviate this, at first additional tuyeres at the side were provided, and then a tuyere which was conducted into the horizontal flue connecting the vertical ones. Nevertheless a uniform heat throughout the whole of the oven could not be attained. The addition of regenerators to the Coppée oven did not affect this point, for their purpose is merely to produce a higher temperature, and the distribution of the heat remained uninfluenced. Hence the idea was adopted of heating the oven from below. Underneath the main flues there are a number of arches which support it. Ten tuyeres convey the necessary gas to each wall. The Bunsen burners by their action draw sufficient air for combustion. The flame mounts vertically into the main flue underneath the side flues into which it ascends. The direction of the flame throughout is the natural one—upwards. There are no angles to negotiate, demanding pressure or draught. The unconsumed gases meet above the vertical flues, and descend by four passages—two for each half of the wall—and pass off underneath the floor of the oven. This interception of the unconsumed gases and its conduction below are necessary if their full heat is to be utilized. The gas required for one side of the oven is distributed at ten different points, and thus the quantity of heat—not the temperture—is also distributed over ten separate areas. Consequently, overheating locally is avoided; in fact, with the new ovens, damage from the melting of the material has not occurred. The mechanical wear of the bricks is the same as with other ovens, and the water used in quenching the coke frequently injures them. By the sub-division, of the gas mentioned, the pressure is equally sub-divided, and therefore rendered more uniform. With refractory material it is impossible to build walls perfectly gas proof, especially when it is subjected to such fluctuations in temperature as occur in coke ovens, which vary from almost 1,200° down to zero; and the communication established between the flues and the interior of the oven may be a source of danger, and the passage of the gas must be counteracted by arranging that the pressure of the gas in the flues is equal, or at least approximately so, to the pressure inside the oven. If the pressure is too high, unconsumed gases enter the passages and pass off through the chimney, and a certain amount of bye-product is lost; if the pressure is still higher, the heated gases pass into the oven, where their high temperature and the air present injuriously affect the coking, the quantity of the bye-products is diminished, and the tar is of inferior quality.

The gases that pass from the oven to the condenser contain from 10 to 12 per cent. of nitrogen with the new Otto oven, which is twice, and even frequently three times, less than with any other kind. This is entirely due to the equal distribution of the heat over the flues and to the shortness of the gas and air passages. The importance of the equilibrium of the pressure inside and outside the oven is demonstrated by the following analyses.

1.—When the gases were purposely, by excessive draught, drawn too quickly from the oven and a pressure of 8 mm. produced, the gas in the oven contained:

N_2	40.2 per cent.
Air	2.4 "
CO_2	4.2 "
H_2	32.7 "
CH_4	15.6 "
Heavy hydrocarbons	1.1 "
CO	4.3 "
	100.5

2.—When the pressure was + 1 mm. (that is, with a weak draught and over pressure in the oven) the gases contained:

N_2	8.3 per cent.
Air	3.3 "
CO_2	2.0 per cent.
H_2	54.0 "
CH_4	26.2 "
Heavy hydrocarbons	1.5 "
CO	4.7 "
	100.0

These analyses prove that in gas No. 1 there was only 53.7 per cent. of combustible gases (H_2 CH_4, heavy hydrocarbons, and CO), whereas gas No. 2 contained 86.4 per cent. The value of the gases increases with their power of combustion.

Samples of gas were also taken from the inlet and outlet passages of the same Otto-Hoffman oven.

(A) After the lapse of the 6-100th part of the coking time the analyses gave the following results:

	Inlet.	Outlet.
N	27 6 per cent.	20.3 per cent.
CO_2	1.4 "	1.5 "
H	42.2 "	47.7 "
CH_4	23.8 "	23.6 "
Heavy hydrocarbons	1.8 "	2.2 "
CO	5.4 "	4.6 "
	102.2 "	99.9 "

(B) After the lapse of the 71-100th part of the coking time the results were as follows:

	Inlet.	Outlet.
N	42.2 per cent.	32.0 per cent.
CO_2	4.0 "	1.6 "
H	36.3 "	47.1 "
CH_4	9.3 "	11.1 "
Heavy hydrocarbons	0.1 "	— "
CO	6.7 "	8.7 "
	99.6 "	100.5 "

These analyses show that in the case of large flues, such as exist in the Otto-Hoffmann oven, on one and the same side, a uniform pressure does not exist. In that part where gas and air are blown into the flues, the pressure is greatest, as is shown by the extra quantity of nitrogen it contains. The case B shows that, in the last stages, the pressure is too low and the gas is too attenuated to prevent the passage of the gases into the flues.

These observations were the cause of an attempt being made to lessen as much as possible the length of the passages in the walls of the oven, for it is easily understood that the shorter the flues the easier it is to attain a uniform pressure, and, besides, the cooking process is hastened. This could be arrived at either by increasing the temperature or by generating a greater quantity of heat in a given time. The first suggestion is impracticable, as the conductive qualities of refractory material are not sufficient to obviate the danger of the parts becoming melted. Recourse was, therefore, had to the second proposal. The coking process does not require such excessively high temperatures as are necessary with steel and glass furnaces, and pieces of cast iron that either intentionally or unintentionally have found their way into the coal are discovered afterwards intact. The process rather requires an abundance of heat. So long as pure gas is regularly and in sufficient quantities supplied to the oven, the storage of heat and the heating of the air can be dispensed with.

As already mentioned, the new type of oven has beneath each of its sides 10 burners. The walls contain 32 vertical flues, of which 4 serve for carrying off the unconsumed gas; so that the 8 inner burners each feed 3 flues, and the 2 outer ones 2 flues each. Before entering the flues the flames have proceeded a distance of 3 feet, of which one-half—in the main passage under the flues—is open, and does not impede the spreading of the flame. This is, therefore, the point of greatest heat. The tongue of flame ascends the flues, and the waste heat of the 28 flues united into the 4 flues for carrying off the waste gas heat—the latter to a sufficient degree. The greatest heat is, therefore, produced where it is most needed—viz., at the bottom; and overheating of the upper part of the oven, where it would be injurious to the bye products, is avoided. The gas is practically wholly burnt and consumed in the oven.

The air necessary for combustion is partly obtained inside the burner, which is of the Bunsen type, and partly rushes in and mingle with the gas and air mixture; so that total combustion is attained the more easily, as the air, without any special apparatus, reaches the combustion chamber at a temperature of 400°. Underneath the arches beneath the oven the temperature is 60°; but the air derives heat from

the floor of the oven, and so prevents the foundations from becoming overheated. The heating of the air in this simple manner also constitutes a gain in the amount of useful heat, which otherwise would be lost, and avoids the necessity of absorbing heat from parts where it ought not to be abstracted, as when the air is heated in the walls of the oven or by the waste heat. In the latter case its power of evaporation is diminished, and in the former the time consumed by the coking process is prolonged, not to speak of the inconvenience and the unnecessary complication of the system by placing gas and air flues so close together. The admission of the air is commensurate with the consumption in the combustion chamber. Should the cake of coke or the appearance of the wall indicate that the temperature is either too high or too low, the man in charge has the opportunity of remedying the evil at 10 different points by simply turning a cock. If the whole side is either too cold or too hot, the closing of the flue of the oven in the one case, and the opening of it in the other, will effect the required change of temperature. If the heat in the whole battery is either too low or too high, it can be regulated by manipulating the valves in the waste heat passage. The supervision is therefore wonderfully facilitated. The man in charge has the oven completely under his control, and, by means of the peep holes in the sides and the tuyere holes underneath, he can at all times satisfy himself that everything is in order.

The yield of the new oven is in a corresponding degree good. Out of 60 ovens, as many as 52 may have their charges drawn in one day; and with good coking coal, the number is, as a rule, eight out of ten. The yield of coke per oven (60) and per day (365) was at one establishment 4 1 tons, and the amount of sulphate of ammonia per 10 tons of coke was 164 kilos., and of tar 419 kilos.; whereas in the case of five other establishments furnished with the Otto-Hoffmann ovens the average production was 2.9 tons of coke per oven per day, and 140 kilos of sulphate of ammonia and 325 kilos. of tar per 10 tons of coke. The new type of oven produces bye-products of superior quality. This is especially noticeable in the case of the tar produced, which is richer in hydrocarbons, which are more liable to decomposition by heat and unconsumed gas than nitrogen compounds. In the case of two ovens, the analyses gave the following results:

	(1) New Type of Oven.	(2) Brunck Oven.
Naphthaline	10 per cent.	6.5 per cent.
Phenol and creosol	2 "	1.5 "
Oils	17 "	12.0 "
Anthracene	5 "	5.0 "
Anthracene oil	23 "	22.0 "
Pitch	40 "	50.0 "
Loss	3 "	3.0 "
	100 "	100.0 "

The new Otto oven, therefore, produces 10 per cent. less pitch than the other.

In consequence of the purity and the absence of any foreign admixture, the gases of the new oven develop from 4,200 to 4,600 units of heat per cubic meter during combustion; whereas the Otto-Hoffmann ovens only produce 3,200 to 4,000 units. The illuminating power is from 10 to 12 candles. The excellence of the gas, as far as bye-products are concerned, depends, of course, on the quality of the coal; for such sorts as are deficient in gas yield less, and that of inferior value. A cubic meter of the gas of one kind is not equal to a cubic meter of that of another. A ton of non-gaseous coal yielded 245 cubic meters, and a ton of gas coal 293 cubic meters. Their respective constituents were as follows:

(A) Non-Gaseous Coal.	Per Cent.	(B) Gas Coal.	Per Cent.
H_2	66.8	H_2	56.3
CH_4	27.9	CH_4	30.3
Heavy hydrocarbons	1.6	Heavy hydrocarbons	4.6
CO	4.2	CO	8.8
	100.5		100.0

In case A, the heating value of 1 cubic meter of gas was 4,488 units of heat; and in case B, 5,068 units. This will give for the value of the gas from 1 kilo. of coal in case A 1,100 units, and in case B 1,485 units. For coking a certain quantity of coal, a definite amount of heat is necessary. The waste heat must leave the oven at a temperature at least equal to the temperature required for coking coal. To attain this result, naturally, in the case of combustion without previously heating the air, more gas is required—that is to say, so much more as is necessary to produce the number of units of heat obtained from the heated air; and it might be supposed that in each case the waste heat would be the same. This is, however, not the case; the loss of heat in ovens worked with superheated air is greater, as the investigations as to the production of steam prove. An Otto-Hoffmann oven with a consumption of 246.5 tons of coal per day produced 0.50 kilo. of steam per kilo of dry coal; whereas the new type of oven produced 1.15 kilos.—that is to say, more than double—and attains up to within 8 per cent the evaporative capacity of an ordinary beehive oven, which may be taken as 1.25 kilos. per kilo. of dry coal. Should the production of the new ovens be increased, it is not impossible that even this 8 per cent. may disappear; for by doing so the loss of heat in a given time would be still further diminished. In the case of the new ovens, the production of steam is increased by the moderate draught that they require with their exceedingly simple gas courses, in consequence of which the waste heat has time to part with its heat, which is equal to about 1,100°.

About one-third (over 1,200) of the recovery ovens in the Rhenish Westphalian district will in the year 1900 be of the new type; and the production of coke from the beehive ovens, which in 1898 was only equal to that of the bye product class, will be relatively still further diminished.

Is Electricity Dutiable?

The United States Treasury Department has been called upon to render a decision on the question of electricity transmitted from the Dominion of Canada being dutiable. The ruling on the subject cannot fail to have a far reaching influence and the effect will be important in several places. Especially will it be important in connection with the development about Niagara Falls on both sides of the river. Considering the growing interest and success manifested and attained in the transmission of the electric current, it is not strange that it should become a border question, and find its way into the Department in Washington for a ruling. It has been intimated that the subject was brought to the attention of the Department by the Niagara Falls Power Company, but Vice-President William B Rankine has referred to such statement as being incorrect.

There is no doubt, however, that the development and prospective development in and about Niagara is what has brought the question into prominence, and it is more than possible that men who have or are about to become interested in certain Canadian projects have seen the wisdom of securing a ruling on the question of the propriety of a tariff on the current. In the daily press, the Ontario Power Company are mentioned also as being interested in the decision, but the fact is there is no such power company in the Dominion. There is, however, a Dominion Power Company, the name of which was formerly the Ontario Power Company, and the names may have been confused. This Dominion Power Company hold a charter from the Dominion Government to develop power on the Canadian side at Niagara by means of a canal. Heretofore the exclusive privilege enjoyed by the Canadian Niagara Power Company in Victoria Free Park, on the Canadian side, has delayed the company's progress, if they really wished to go ahead, from the fact that they could not get the privilege of discharging water into the lower Niagara through the park lands. But within a few months past the Canadian Niagara Power Company have relinquished all exclusive rights in the park, and if the Ontario Government and the Victoria Park Commission agree the company may get tailrace rights through the park lands.

This Dominion Power Company are disposed to be competitors for business with the Canadian Niagara Power Company. This latter company are backed by practically the same capital that the Niagara Falls Power Company have to make their work so successful. It is evident that the Canadian Niagara Power Company and the Niagara Falls Power Company would be and are two powerful allies, and the exchange of current from central stations might be of vast importance in case of accident to either station of the companies If no duty was assessed on the current so transmitted it is probable that the exchange might be made with greater freedom and in greater volume than if a duty was assessed on the current transmitted. In any event, the operation of two great power plants such as the one built by the Niagara Falls Power Company and the one proposed by the Canadian Niagara Power Company as an aid to each other in time of need would be of great value to all industries located at Niagara, no matter on what side of the river.

The Niagara Falls Power Company have just completed a vitrified tile conduit from their power station to the upper steel arch bridge, and through this conduit and over the arch it is proposed to carry cables for the transmission of electric current from the big power house at the Falls, on the New York side, to the Canadian side. Until a few months ago the electric current service on the Canadian side was sup-

lied through an installation of the Canadian Niagara Power Company in the station of the Niagara Falls Park & River Railway, but the destruction of this station by fire made connection with the power service on the New York side quite necessary, a fact that led to the construction of the conduit referred to, the cables in which are soon to be laid. The possibilities of development on the Canadian side favor a cheaper development and a development on more extensive lines than on the New York side, but in Canada there is not the demand for power that there is in the States. This fact has led to the hope that in time Buffalo would receive a power supply from the Canadian side Should a duty be placed on the current, Buffalo would stand little show of being connected to the contemplated station. Many other points on the frontier will watch the decision of this question with a great deal of interest, but its importance is such that it undoubtedly will go to the highest courts before a definite result is obtained. There is good reason to believe that should the United States place a tariff on electricity Canada would not be long in following suit, as it is believed that the Dominion Government has already expressed the idea that the current should be taxed. Should the United States admit electricity free other governments might do the same. Where there is the greatest demand for any article there is the greatest and most active market; but, considering all things at Niagara, and the extensive development there by both the Niagara Falls Power Company and the Niagara Falls Hydraulic Power & Manufacturing Company, there is little reason to conclude that the power development at Niagara Falls needs any protection from the proposed Canadian development, whereas the close business relations that must necessarily exist between the Niagara Falls Power Company and the Canadian Niagara Power Company, which probably will always be the greatest power concerns in the world, must of necessity be vastly beneficial to both sides of the river at Niagara and the industries now there and those to come.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

THE proprietors of the Logan Iron Works, of Brooklyn, N. Y., have been authorized to construct a gasholder, up to retaining 40,000 cubic feet, for the Winston-Salem (N. C.) Company.

MR. GEORGE B. EDGAR informs us that the Coshocton (Ohio) Light, Fuel and power Company has disposed of its gas plant to Messrs. Sapp & Beam, of Mount Vernon, Ohio; and the latter took possession the first inst.

THE following letter explains itself :

KENTUCKY HEATING COMPANY,
LOUISVILLE, KY., Dec. 27, 1899.

To the Editors AMERICAN GAS LIGHT JOURNAL: In your issue of December 25th, 1899 you reprint a resolution, passed by the Board of Public Works, of Louisville, in which they state as a fact that the Kentucky Heating Company has violated, not only the ordiance governing the case, but "its agreement made with us last summer as well. When we finally reconsidered our first decision some months ago and allowed the Kentucky Heating Company permits, it was upon the express understanding that its gas was not to be used for illuminating purposes, but simply for heating. Finding that this agreement had not been lived up to by the Heating Company we declined to grant it any more permits." The violation of an ordiance by a gas company is a question of law and of fact, but the violation of an agreement is one which I consider much more serious, as it affects the personal integrity of the officers who made such an agreement and then violated it. As a matter of fact the Kentucky Heating Company distinctly declined to make the agreement which the Louisville Gas Company, speaking through the Board of Public Works, asked that it be compelled to make. The Board asked the Kentucky Heating Company to agree that it would sell no gas except natural gas, and that it would guarantee that none of this gas should be used for lighting purposes. Our reply was that we could not make such an agreement, and could not enforce it even if we made it; and that we preferred to cease making street connections until the Courts could act rather than make such an agreement. So many people demanded natural gas connections, and demanded them with such emphisis, that the Board of Public Works began to cast around for some method of receding from a very unpopular position. They finally granted permits in the exact language of the orginal ordiance, with distinct notice that we would construe the ordinance as we had always done, until the Courts should promulgate a different construction. The matter rested in this shape, until after the election, and then the pronunciamento, which you published, was promulgated. The Kentucky Heating Company is at present making no street connections, and will not make any, until some other authority, higher than the Board of Public Works, shall pass on the question. This condition of affairs is bad enough, and illustrates the evil of mixing politics with business. We can get along very well for a while without making new connections; we cannot, however, and will not, rest under the charge of having made an agreement and then violated it. There is absolutely no truth in it. The whole transaction was in writing. We have copies of every paper, and can prove the exact truth of this statement. I have found it impossible to make this letter shorter, but hope you wil find room for it, owing to the charge of bad faith contained in your former article. Very truly yours, DONALD MCDONALD, President Kentucky Heating Company."

AT the annual meeting of the Auburn (N. Y) Gas Light Company these officers were chosen: Directors, F. E. Hughitt, J. W. Dunning, S. C. Payne, E. H. Avery, J. C. Reed, D. M. Dunning, N. B. Eldred, D. A. Smith and G. B. Turner. President, E. H. Avery; Vice-President, J. C. Reed; Treasurer and General Manger, D. M. Dunning.

ADVICES from Easton, Pa., are to the effect that the Warren County Gas Light Company, of Phillipsburg, N. J., has been reorganized under the corporate title of the Peoples Light, Heat and Power Company of Phillipsburg. Under the charter of the succeeding corporation it may manufacture, distribute and sell gas, electricity or steam for the purpose of producing light, heat or motive power. No change was made in the executive management.

MR. JOHN L. HARTMAN, for years prominent in the artificial lighting business of Lancaster, Pa., died at his home in that city, December 26, 1899. He was in his 69th year.

A CORRESPONDENT in Utica, N. Y., writing under date of December 30th last, says: "One of the oldest and most successful firms in Central New York, conducting a wholesale business in hardware, tinners' and plumbers' supplies, was the firm of Charles Millar & Son, of Utica, N. Y., which has just been incorporated as Charles Millar & Son Company under the laws of the State of New York, with $200,000 capital. The business was originally started by Charles Millar in 1861. In 1866 the firm was organized by the admission of Henry W. Millar, and the firm has not been changed since; although in 1883 John L. Murray was admitted as a partner. In 1890 Charles Millar died, and on Aug. 4th, 1899, John L. Murray died. The business has been carried on since the latter date by Henry W. Millar, the sole surviving member of the firm. The latter, in order to relieve himself from some of the close application and attention required in so large a business, and also perhaps to secure a greater degree of permanency, decided to incorporate the Company, and in doing so secured the co-operation of Messrs. Charles S Symonds, Nicholas E. Kernan and Jno. A. Kernan, of Utica; and Edward G. Wagner, of Whitesboro, N. Y. These gentlemen, and Mr. Henry W. Millar, comprise the Board of Directors. The other officers of the Company are: President and Treasurer, Henry W. Millar; Vice-President, Charles S. Symonds; Secretary, John A. Kernan; Manager. Levi H. Birdseye; Assistant Treasurer, Alfred H. Dobson. The business in all its branches will be continued by the new Company."

"L. F. S.," writing from Los Angeles, Cal., under date of December 26th, 1899, says: "I inclose a statement printed in the Los Angeles *Express* of yesterday." The clipping is appended: "The Los Angeles Gas Company announces a reduction in the price of gas to $1.50 per 1,000 cubic feet. The price has heretofore been $1.65. There is to be no more cutting in electric light rates for the time being, and the indications are that the fierce war inaugurated in the business districts by the three local companies last winter is at an end for good. Orders have been issued to all lighting solicitors to discontinue the practice of giving discounts, and all new contracts are being signed at an advance of from 60 to 100 per cent. over the figures that recently prevailed. The expected pool in electric lighting has not yet been effected, negotiations with that end in view being still on. Conferences are being held almost daily, and it is expected that some sort of agreement will have been reached by all of the interests concerned early in the new year."

JUSTICE DUNN, of San Francisco, has rendered an opinion in the case of the Union Collection Company against H. G. Cupples, in which he decides that the legal rate that may be charged for gas is $1 50 per 1,000 cubic feet in San Francisco. Previous to July 1st, 1899, it is held that the legal rate was $1.75, the resolution of the Board of Supervisors, of April 3, 1899, fixing the rate at $1.10, being declared illegal. The case

was brought in the interest of the San Francisco Gas and Electric Company. Cupples was a gas consumer, and offered to settle his bill rendered on the basis of $1.10 per 1,000 for gas used between the dates of April 3d and July 10th, and on the basis of $1.50 per 1,000 for gas used since July 10th. The Company insisted on the $1.75 rate up to July 10th, and on the $1.50 rate subsequently. The Judge sustained the Company's contention.

MR. E. G. PRATT, Manager of the Capital City Gas Light Company, of Des Moines, Iowa, on behalf of its proprietors, made the following announcement to the residents, under date of the 1st inst.:

"On January 1st, 1900, the price of gas will be reduced to $1.20 per 1,000 cubic feet. This is made in compliance with our contract with the city. In this connection we desire to call your attention to a few important facts:

"*First.*—While the price of all commodities has advanced, we are compelled to sell our product (gas) at a reduced figure.

"*Second.*—With the advance in the cost of labor and raw materials entering into the manufacture of things of every description, the manufacturer and merchant are compelled to advance prices of the finished product; yet we, the Gas Company, even though everything used by us in the manufacture of gas costs more than during any recent period, we are compelled to reduce our price.

"A reduction of 5 cents per 1,000 cubic feet of gas does not mean so very much to the consumer, but it means a loss of about $6,250 per year to us. Add to this loss the advance in wages and the cost of the raw materials, and we have an additional amount to be compensated for.

"How can this be done? In only one way that we know of, viz.: To increase the number of our consumers and thereby increase our consumption.

"With this object in view, we shall pursue the same policy as heretofore, with respect of free service connections, gas appliances of all kinds at factory prices, house piping and gas fixtures at cost.

"We solicit your patronage and beg to remind you that your interests are ours, and we assure you that it is our desire to serve you honestly and well."

THE reorganization of the gas and electric lighting interests of Lexington, Mass., has been perfected. The undertaking corporation is to be known as the Lexington Gas and Electric Company. It is capitalized in $40,000, and its executive officers are: President, Ellery I. Garfield; Treasurer, Charles H. Miles.

CAPT. J. J. VANDERGRIFT, a noted pioneer in the petroleum development of America, died at his home in Pittsburg, the evening of December 26th. Deceased was in his 72d year.

MR. GEORGE W. STARR, General Manager of the Wallingford (Conn.) Gas Light Company, died suddenly at the Hotel Garde, Wallingford, the afternoon of December 25th. Deceased, who was in his 38th year, had been in charge of the Wallingford Company since April, 1899. The funeral services were held in the home of his brother-in-law, Mr. Peter Terhune, of New Haven, the afternoon of December 28th.

A SWINDLER named Charles Harting, who said he resided in Baltimore, Md., was recently arrested in East St. Louis, Ills., where he had been collecting gas bills by fraudulently representing himself as an employee of the local gas company. Under the name of Hastings he had tried a similar game in Evansville, Ind., but escaped arrest. There is little doubt that Harting-Hastings, or whatever other name he elects to be known in the various districts in which he operates, is the chap who victimized several residents of Baltimore some weeks ago, quite like the manner in which he swindled some of the gas users of Evansville and East St. Louis. A fair account of the way in which he operated in Baltimore is contained in our items for December, 18, 1899.

A CORRESPONDENT forwards the following clipping from the Northampton (Mass.) *Gazette*, dated Dec. 26, 1899—the hotel named is a prominent hostelry of Northampton: "Rosser Mitchell, the colored porter at the Mansion House, was badly injured about his head by the explosion of an acetylene gas generator at that house Saturday afternoon. About a week ago the generator was put into the basement of the house, as an experiment, by a Springfield firm. It was to be given a 30 days' trial. It was claimed for the machine that it would give a light equal to 200 candles. The thing worked very well for several days and proprietors of other hotels came in to look at it. But Friday night the machine would not generate, and the Mansion House people had to go back to the primitive methods of lighting. Henry G. Pratt, of Springfield, and R. T. Rudd, of Holyoke, who are connected with the Company supplying the new machine, came to remedy the matter. The machine was taken apart, and Mr. Rudd, with a lighted candle in hand, was examining the parts, when there was a puff and a shower of whatever happened to be around. The porter was assisting Messrs. Pratt and Rudd, and besides the injuries he received about his face, which it is feared may result in the loss of the sight of both eyes, he was severely cut about the arms and legs. Messrs. Pratt and Rudd were only slightly injured." Gas is again used in the Mansion House.

THE dividend on the shares of the Binghamton (N. Y.) Company ($1 per share) is payable the 20th inst.; and so is the regular semi-annual dividend (3 per cent.) on the shares of the Western Gas Company, of Milwaukee.

WE are told that the gas rate for the Montclair (N. J.) district has been fixed by the Essex and Hudson Gas Company, of Newark, at $1.10 per 1,000 cubic feet—a concession of 40 cents per 1,000.

Tests for Incandescent Mantles.

The Committee on Photometry of the German Association of Gas Engineers, in reporting on the matter of tests for incandescent mantles, remarks in part that:

Mantles generally decrease in illuminating power as their time in service increases. On this account a number of gas works expressed a desire for definite and uniform methods of testing mantles with reference to specifications of quality, and including experiments to determine their endurance. No absolutely sure method can be prescribed for meeting these requirements, the illuminating power being influenced or changed by so many different circumstances. For example: Variation in fabric, the size of the wooden form, the mode of burning off and forming, the manner of suspension, the size of the upper opening and the height of the supporting wire. A good fit of the mantle upon the burner head is also of importance, and likewise a section, as nearly as possible, circular. The volume of the portion rising above the burner head should not be too great, since otherwise it will not be completely filled by the flame and consequently will give only a partial illumination. The side walls of the mantle should slope directly downward and must not have a cupola shaped outward curvature at the top. The manner of burning, whether in pure air free from dust or in street air, which is filled with dust, also exerts an influence upon the illuminating power. Some general considerations, however, can be stated as to how the process of testing mantles is to be conducted.

For the test at least two, and usually four, mantles are employed, these being mounted upon similar burner heads. The height of the supporting wire should be 70 mm. (2.75 inches) above the top of the burner head. Only well formed mantles which fit snugly to the burner head should be employed in the test, in order to secure a uniform light at all points of the surface. The burner heads, with their mantles, are fitted to a rack provided with air shutters, having a number of openings, of equal size, for the admission of air under as nearly as possible uniform conditions. The shutters must be regulated singly, in order to secure, as nearly as possible, the same hourly consumption of gas, between 115 and 125 liters (4 to 4.44 cubic feet) for the same pressure.

Before the regulation of the shutter or jet, the incandescent mantles which are to be placed upon them are allowed to burn about one half-hour with the consumption stated, at 40 mm. (1.57 inches) or at the pressure adopted at the place in question, in order to give them, by this means, the proper form. The adjustment of the gas injector is made at the pressure in use at the place in question, say, of 30-40 mm. (1.18 to 1.57 inches) the orifices of the injector being gradually enlarged until the greatest luminous effect has been reached, *i. e.*, when the mantle gives a uniform illumination throughout and no forcing of the flame out of the top occurs. The hourly consumption then lies between 115 and 125 liters (4 to 4.4 cubic feet).

As a check upon the proper regulation let the pressure be reduced about 5 mm. (0.2 inch) and observe that the illuminating power will then be less by from 4 to 5 Hefner candles. The consumption must be measured at the pressure employed at the beginning, which must be the same for all the experiments. The adjusted burners, together with the incandescent mantles and chimneys, are set again upon the rack and are kept burning under the pressure adopted in the city using them, which pressure is maintained constant by means of a pressure regulator. After one hour's burning the burner heads are taken off and are taken into the photometer chamber where they are tested in one and the same Bunsen tube under a constant pressure and gas consumption.

(*Continued on page 55.*)

THE AMERICAN GAS LIGHT JOURNAL

A. M. CALLENDER & CO.,
PROPRIETORS.

THOS. J. CUNNINGHAM,
ELBERT P. CALLENDER,
EDITORS.

CHAS. E. SANDERSON,
MANAGER.

PUBLISHED ON EACH MONDAY OF THE YEAR AT
No. 32 Pine Street, New York.

The JOURNAL is the official organ of the
NEW ENGLAND ASSOCIATION OF GAS ENGINEERS.
AMERICAN GAS LIGHT ASSOCIATION.
WESTERN GAS ASSOCIATION.
OHIO GAS LIGHT ASSOCIATION.
PACIFIC COAST GAS ASSOCIATION.

TERMS:

SUBSCRIPTION—Three Dollars per annum, in advance. Single copies, 10 Cents.

Notification Respecting Advertising.—Orders for new advertising, or for changes in standing advertisements, to insure attention in the issue following their reception, must be in hand any time of Wednesday.

AGENTS:

New York—American News Co. 39 and 41 Chambers St.
Germany—Lemcke & Buechner, of New York.
England—Aug. Siegle, 30 Lime Street, London.

MONDAY, JAN. 8, 1900.

(*Continued from page* 54.)

The measurement is made in four directions perpendicular to one another, in which process not only the burner head but also the injector along the burner head are turned around. For this purpose use is made of a small revolving scaled base manufactured by Dr. Krüs. This base consists of a fixed cone with an upper portion capable of being turned around it, and for convenient adjustment provided with four small hand spikes and numbers. In the turning of this plate a handspike is placed always upon the fixed mark by means of the second finger. The mean of the measurements taken, which are at least eight in number and in four different directions, gives the proper illuminating power for the pressure and consumption measured.

The variations in the measurements in the four directions must not be greater than about 10 Hefner candles. With greater deviations the incandescent mantles should be rejected as being of improper shape. The use of a secondary standard light is necessary in the determination. For this purpose a small electric incandescent lamp, with accumulators, serves best; but since these are not ordinarily at disposal in most experiments in practice, a so-called Lilliputian incandescent burner, with a pressure regulator inserted, will serve the purpose well. The illumination of this burner is determined before and after the experiments by means of the Hefner lamp, the mean being taken from the figures obtained. The figures read off on the photometer are multiplied by this mean in order to obtain the illuminating power of the incandescent body measured.

The incandescent bodies are brought back upon the rack and allowed to burn there, during which time, as before stated, the gas pressure is maintained constant and at the customarily used pressure. After 100, 200, 300, etc., hours of burning, the burner heads are taken off and again tested. In practice, however, the measurements after 1, 100 and 600 hours of burning will suffice for judgment of the quality of the mantles. The diminution in the illuminating power determined by this test furnishes a measure of the quality of the mantle.

The Oechelhaeuser Gas Engine.

The London *Journal* "notes" that Mr. Bryan Donkin, in the *Engineer*, speaks well of the Oechelhaeuser gas engine for working directly with blast furnace gas. The writer refers to the striking discovery of the last few years that the blast furnace is an ideal gas generator, the importance of which is only now being perceived. The practical difficulties in the way of using blast furnace gas for motor power purposes have been almost completely overcome. That of its low heating value—about one-fifth that of coal gas—is met by the use of much higher compression in the engine cylinder. The worst trouble is the dusty character of the gas; but this has been largely got rid of by sufficient washing. The only really serious difficulty in the way of the utilization of blast furnace gas lies rather with the engine than with the fuel, and is a question of the possibility of making gas engines large enough to enable the gas to do the work which is waiting for it. Small motor units are of no good in this connection. The engine must be proportionate to the large fuel supply and the heavy work to be done; and about 600-horse power units is the minimum. The Oechelhaeuser engine is characterized as specially suited for blast furnace gas. It is of peculiar design, having one long cylinder, in which two cylinders (one at each end) work in opposite directions; and there is an auxiliary double acting air pump. The working charge is compressed to 8 or 10 atmospheres at the inner end of the stroke, when the two cylinders are nearest together, and the ignition is electrical. The cycle which now begins is too complicated to decribe shortly; but the engine is reported to be working well at the Hörde Iron Works, in Westphalia. It is being made in sizes up to 1,500-horse power with a single cylinder.

The Market for Gas Securities.

The "sensation" of the week in city gas circles was the announcement that the Consolidated Gas Company had formed a working alliance with the New York Gas and Electric Light, Heat and Power Company. While this agreement had been to all intent known by many for some months, it is nevertheless now officially confirmed. That it is of importance as affecting the local artificial lighting situation is true, but that it is everything in respect thereto is far from fact. Consolidated sold up to 199 and down to about 191 during the week, with the close to-day (Friday) at 192 to 194½. There is no particular change in other city gas shares, save that Amsterdams are nominally in better demand.

Brooklyn Union moved up sharply, as also did Peoples, of Chicago. Lacledes were steady, while Baltimore Consolidated showed weakness. On the surface, the indications favor higher prices generally.

Gas Stocks.

Quotations by George W. Close, Broker and Dealer in Gas Stocks.

16 WALL STREET, NEW YORK CITY.

JAN. 8.

☞ All communications will receive particular attention

☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$39,078,000	100	192	194
Central Union, Bonds, 5's	3,000,000	1,000	107½	108½
Equitable Bonds, 6's	1,000,000	1,000	105	..
" 1st Con. 5's	2,300,000	1,000	115	18
Metropolitan Bonds	658,000	..	108	112
Mutual	3,500,000	100	300	305
" Bonds	1,500,000	1,000	100	102
Municipal Bonds	750,000	..	..	..
New Amsterdam Gas Co.	13,000,000	100	24	25
Preferred	10,000,000	100	45	46
Bonds, 5's	11,000,000	1,000	94	95
Northern Union, Bonds, 5's	1,250,000	1,000	95	97
New York and East River..				
Bonds 1st 5's	3,500,000	1,000	109	111
" 1st Con. 5's	1,500,000	..	112	114
Richmond Co., S. I.	348,650	50	70	..
" Bonds	100,000	1,000	..	..
Standard	5,000,000	100	98	103
Preferred	5,000,000	100	110	125
Bonds, 1st Mortgage, 5's	1,500,000	1,000	110	114
Yonkers	299,65	500	130	..
Out-of-Town Companies.				
Brooklyn Union	15,000,000	100	147	147½
" " Bonds (5's)	15 000,000	1,000	118	119
Bay State	50,000,000	50	1¼	1⅝
" Income Bonds	2,000.000	1,000	..	75
Binghamton Gas Works	450,000	100	40	..
" 1st Mtg. 5's	475,000	1,000	96½	99½
Boston United Gas Co.—				
1s Series S. F. Trust	7,000,000	1,000	92	..
2d " " "	3,000,000	1,000	68	71
Buffalo City Gas Co.	5,500,000	100	9	11
" " Bonds, 5's	5,250,000	1,000	84	85
Central, San Francisco	2,000,000	..	106	108
Chicago Gas Co. Guaranteed Gold Bonds	7,650,000	1,000	104	104¼
Columbus (O.) Gas Co., 1st Mortgage Bonds	1,207,000	1,000	106	108
Columbus (O.) Gas Lt. & Heating Co	1,682,780	100	60	65
Preferred	3,026,500	100	84	86
Consumers. Jersey City Bonds	600,000	1,000	102	105
Cincinnati G. & C. Co.	8,500,000	100	197	197¼
Consumers, Toronto	1,700,000	50	230	235
Capital, Sacramento	500,000	50	..	35
Bonds (6's)	150,000	1,000	..	..
Consolidated. Baltimore	11,000,000	100	51¾	..
Mortgage, 6's	3,600,000	..	..	118
Chesapeake, 1st 6's	1,000,000	..	..	..
Equitable, 1st 6's	910,000	..	..	..
Consolidated, 1st 5's	1,490 000	..	..	112
Consolidated Gas Co. of N.J.	1,000,000	100	21	23
" Con. Mtg. 5's	380,000	1,000	87	90
Consolidated G. & E. Co.'s., Little Falls, N.Y.	90,000	100	..	100
Bonds	75,000	..	..	100
Detroit City Gas Co.	4,560,000	50	95¾	96
" Prior Lien 5's	4,598,000	1,000	99½	100
Detroit Gas Co., 5's	386,000	1,000	100	101
" Inc. 5's	16,000	100	100½	101
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Fort Wayne	2,000,000	..	77	83
" Bonds	2,000,000	..	80	85
Grand Rapids Gas Lt. Co.	1,000,000	50	..	..
" 1st Mtg. 5's	1,125,000	1,000	..	..
Hartford	750,000	25	..	220
Hudson County Gas Co., of New Jersey	10,500,000	..	25	..
" Bonds, 5's	10,500,000	..	102	105
Indianapolis	2,000,000	..	122	128
" Bonds, 6's	2 650,000	..	105	106
Jackson Gas Co.	230,000	50	72	78
" 1st Mtg. 5's	250,000	1,000	101	102½
Lafayette Gas Co., Ind.	1,000,000	100	68	70
Bonds	1,000,000	1,000	81	86
Louisville	2,570,000	50	106	
Laclede, St. Louis	7,500,000	100	7	80
Preferred	2,500,000	100	100	..
Bonds	10,000,000	1,000	107	
Madison Gas & Elec. Co.	400,000	100	82	
" 1st Mtg. 6's	350,000	1,000	102½	108
Montreal, Canada	2,000,000	100	200	..
Newark, N. J., Gas Co.	16,000,000	..	50	60
Bonds, 6's	4,600,000	..	107	108

New Haven	1,000,000	25	280	300
Nashville Gas Lt. Co.	1,000,000	50	110	..
Oakland, Cal.	2,000,000	..	43	45
" Bonds.	750,000	..	..	..
Peoples G. L. & Coke Co., of Chicago	25,000,000	100	105¼	105⅛
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	20,100,000	1,000	111⅝	111½x
2d "	2,500,000	1,000	104	105
Rochester Gas & Elec. Co.	2,150,000	50	88	..
Preferred	2,150,000	50	118	..
Consolidated 5's	2,000,000		87½	90
San Francisco, Cal.	10,000,000	100	55	57
St. Paul Gas Light Co.	1,500,000	100	57½	58½
1st Mortgage 6's	650,000	1,000	82	85
Extension, 6's	600,000	1,000	..	..
General Mortgage, 5's	2,428,000	1,000	88	90½
St. Joseph Gas Co.	1,000,000	100	42	44
" 1st Mtg. 5's	750,000	1,000	96½	98
Syracuse, N. Y.	1,750,000	100	15½	18
Bonds	1,612 000	1,000	81	84
Washington, D. C	2,000,000	20	285	..
First mortgage 6's	600,000	..	.	..
Western, Milwaukee	4,000,000	100	106¾	107¾
Bonds, 5's	3,830,500	.	106	108
Wilmington, Del.	600,000		220	50

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DIVIDEND NOTICE.

OFFICE OF THE UNITED GAS IMPROVEMENT CO.,
N. W. CORNER BROAD AND ARCH STS.,
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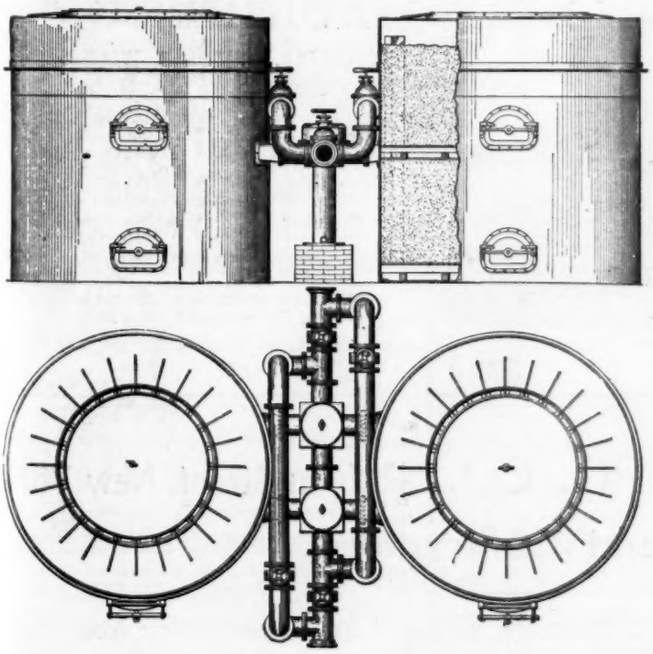

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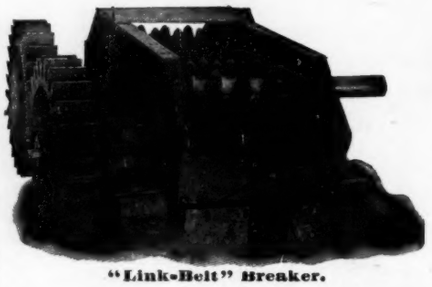

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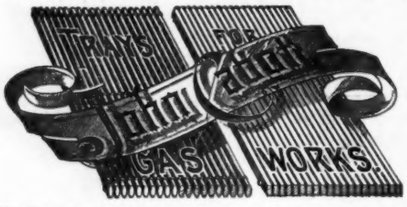

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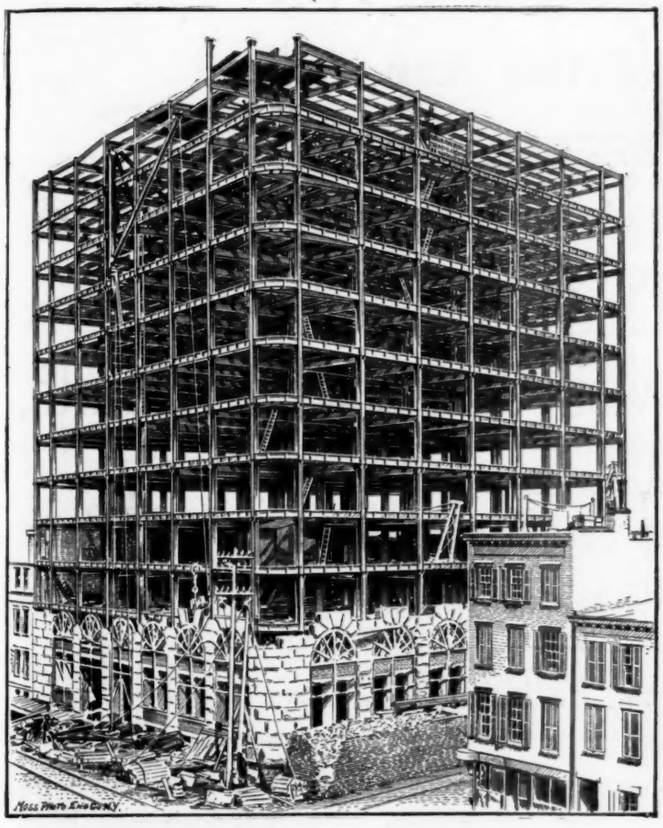

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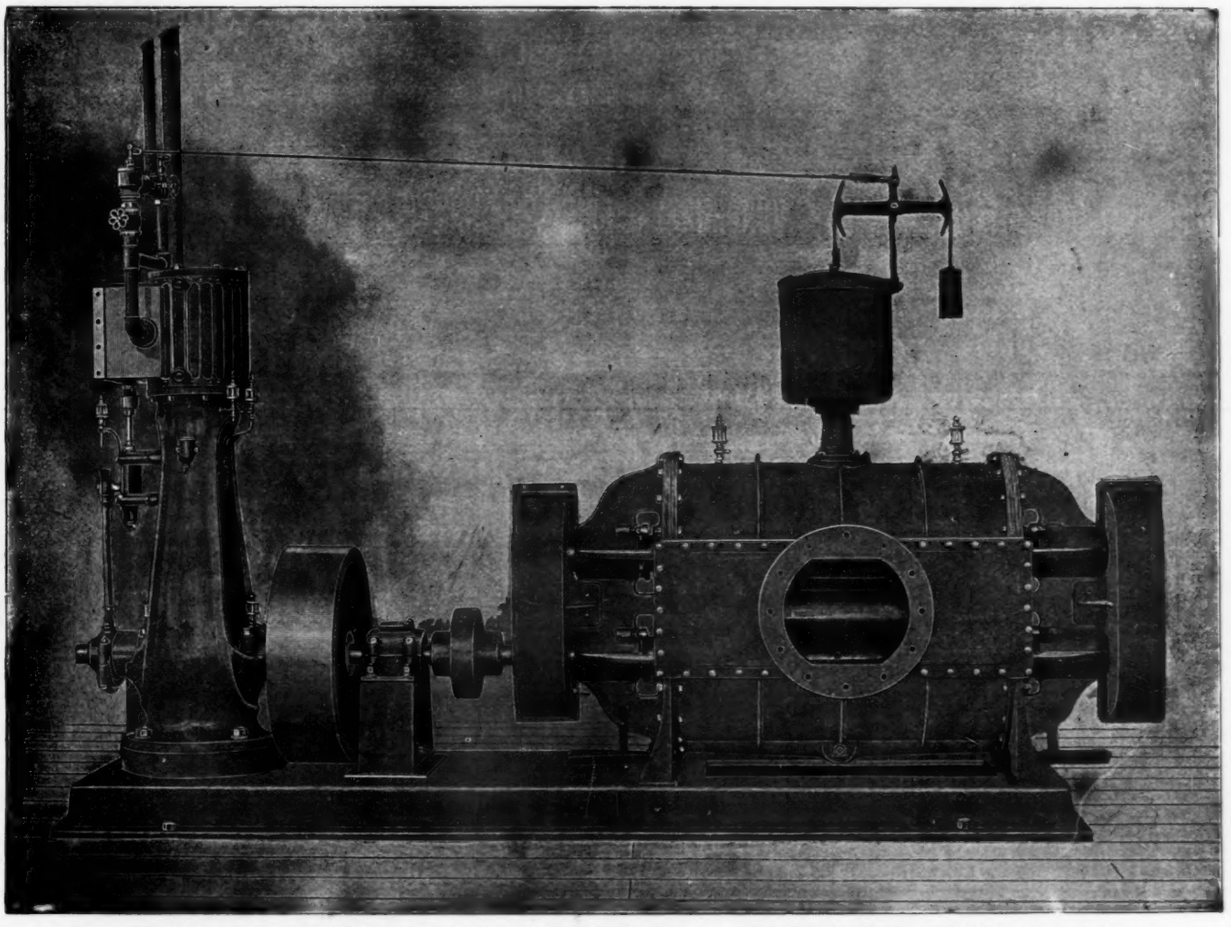

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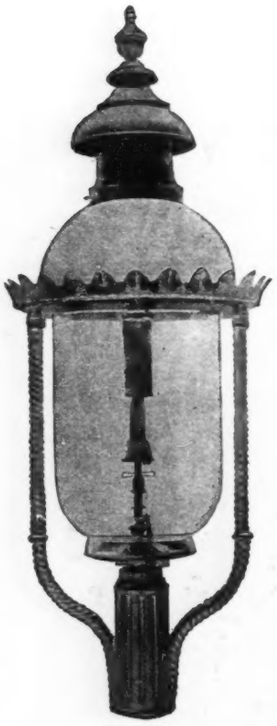

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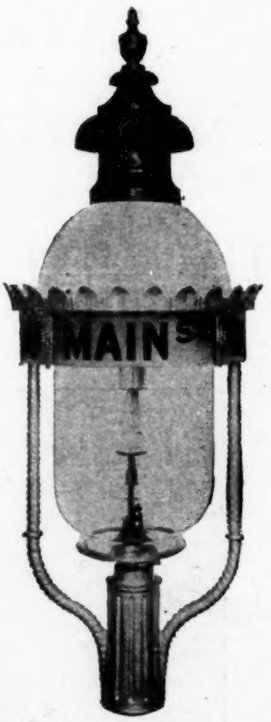

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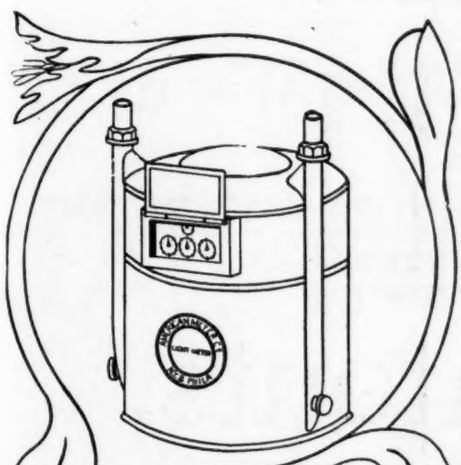

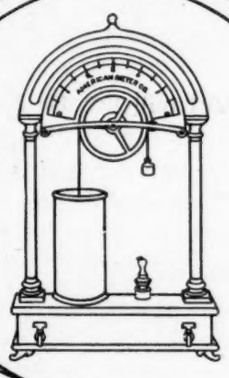

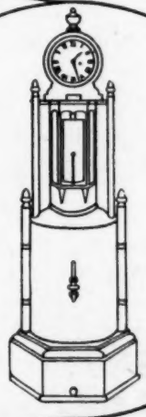

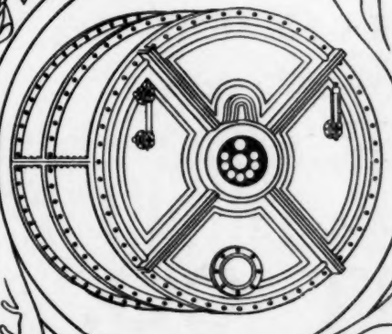

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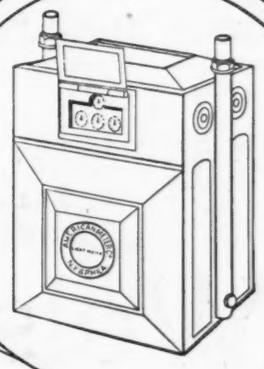

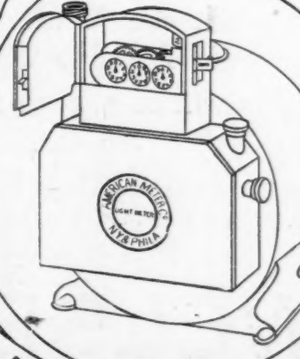

PUBLIC LIGHTING TABLE.

JANUARY, 1900.

Day of Week.	Date.	Table No. 1. Following the Moon. Light.	Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Extinguish.
				P.M.	A.M.
Mon.	1	5.20 PM NM	6.20 AM	4.30	6.30
Tue.	2	5.20	6.20	4.30	6.30
Wed.	3	5.20	6.20	4.30	6.30
Thu.	4	5.20	6.20	4.30	6.30
Fri.	5	5.20	6.20	4.30	6.30
Sat.	6	10.10	6.20	4.30	6.30
Sun.	7	11.30 FQ	6.20	4.30	6.30
Mon.	8	12.30 AM	6.20	4.40	6.30
Tue.	9	1.40	6.20	4.40	6.30
Wed.	10	2.40	6.20	4.40	6.30
Thu.	11	3.40	6.20	4.40	6.30
Fri.	12	4.30	6.20	4.40	6.30
Sat.	13	5.20	6.20	4.40	6.30
Sun.	14	No L.	No L.	4.40	6.30
Mon.	15	No L. FM	No L.	4.50	6.25
Tue.	16	No L.	No L.	4.50	6.25
Wed.	17	5.30 PM	8.10 PM	4.50	6.25
Thu.	18	5.30	9.10	4.50	6.25
Fri.	19	5.30	10.00	4.50	6.25
Sat.	20	5.30	11.00	4.50	6.25
Sun.	21	5.40	12.00	4.50	6.25
Mon.	22	5.40	1.00 AM	5.00	6.25
Tue.	23	5.40 LQ	2.00	5.00	6.25
Wed.	24	5.40	3.00	5.00	6.25
Thu.	25	5.40	4.00	5.00	6.25
Fri.	26	5.40	5.00	5.00	6.25
Sat.	27	5.40	6.10	5.00	6.25
Sun.	28	5.50	6.10	5.00	6.25
Mon.	29	5.50	6.10	5.05	6.15
Tue.	30	5.50 NM	6.10	5.05	6.15
Wed.	31	5.50	6.10	5.05	6.15

TOTAL HOURS LIGHTING DURING 1900.

By Table No. 1.	Hrs.Min.	By Table No. 2.	Hrs.Min.
January	230.50	January	423.20
February	175.40	February	355 25
March	189.00	March	355.35
April	160.30	April	298.50
May	150.40	May	264.50
June	137.00	June	234.25
July	152.00	July	243.45
August	171.50	August	280.25
September	187.20	September	321.15
October	213.10	October	374.30
November	221.50	November	401.40
December	231.50	December	433.45
Total, yr.	2221.40	Total, yr.	3987.45

THE RECENT DECISION.

The United States Circuit Court of Appeals,

In Its Opinion of December 7, 1899,

FINALLY AND FULLY SUSTAINS THE WELSBACH COMPANY'S PATENT.

DEALERS and USERS and MANUFACTURERS are CAUTIONED against INFRINGEMENT of the

Welsbach Patents.

Judge LACOMBE, in the United States Circuit Court, handed down the following opinion Saturday, Dec. 9, 1899.

On motion to restrain complainant from sending circulars to the customers of American Incandescent Lamp Company.

LACOMBE, Circuit Judge.

Irrespective entirely of the preliminary objection that affirmative relief of this sort will not be granted to defendant—a question not now passed upon—there seem no good grounds for criticism of complainant's circular. It states that Judge Townsend enjoined the "manufacture and sale" of infringing mantles, and he did grant such an injunction. And this Court has enjoined the sale of mantles which the person enjoined did not himself manufacture, when his past conduct in the matter of infringement created a special equity in favor of the complainant against him. It is true that the circular goes further, and threatens suit against persons who sell mantles, but who never have been at all concerned in manufacturing or causing them to be manufactured.

In other words, it threatens suit upon the patent as if it were a patent for a product. But the complainant insists that the threat is made in good faith; that it intends to bring suits against sellers of the infringing mantles upon the theory that the patent is really one for a product. In view of the peculiar language of the claim, this Court is not now prepared to hold that such contention would be wholly without merit, or that the complainant could not succeed against a mere seller. Moreover, it is contended that the seller of a purchased mantle himself promotes the taking of the final step in the process, and such contention has not yet been passed upon adversely to complainant. These are questions which should be left to be determined in one of such suits, rather than here. If complainant intends to prosecute one or more sellers, and there is nothing before the Court to induce a disbelief in its assertion that it does so intend, it would seem to be its proper course to warn dealers to desist from selling.

December 9, 1899.

Restraining orders issued in the United States Circuit Courts against—

THE UNITED INCANDESCENT LIGHT COMPANY.
ST. LOUIS INCANDESCENT MANTLE COMPANY.
ECKERLE ELECTRICAL COMPANY.
H. KUPFER.
THE NEWBY INCANDESCENT MANTLE COMPANY.

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LOWE WATER GAS APPARATUS.

Total Sets Installed to January 1, 1900, - - - - - - - - 327

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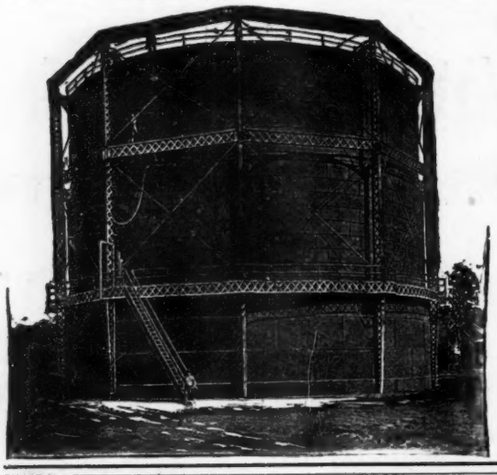

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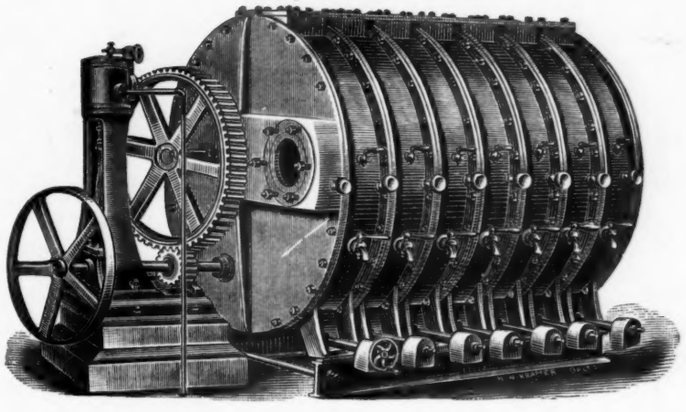

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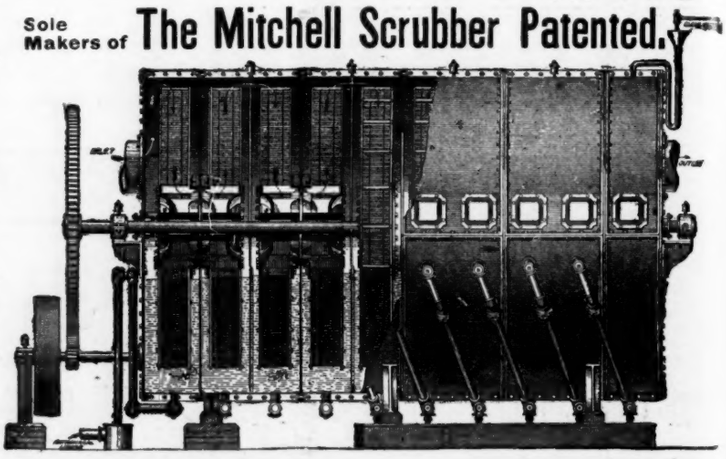

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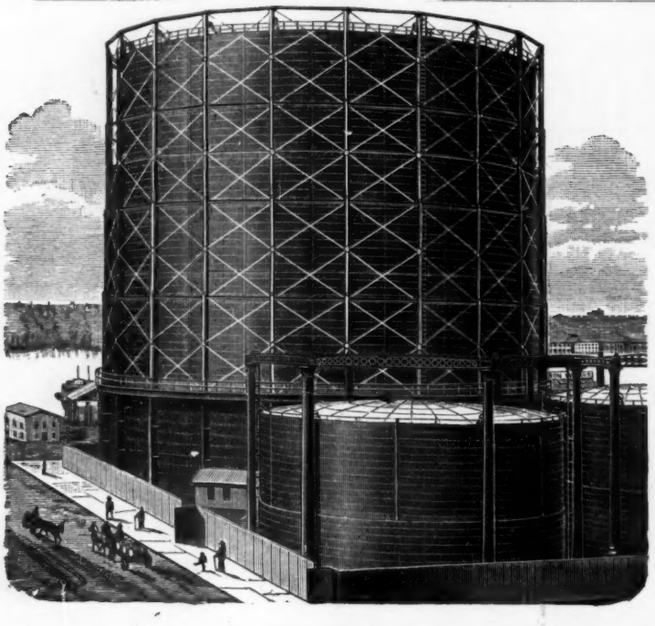

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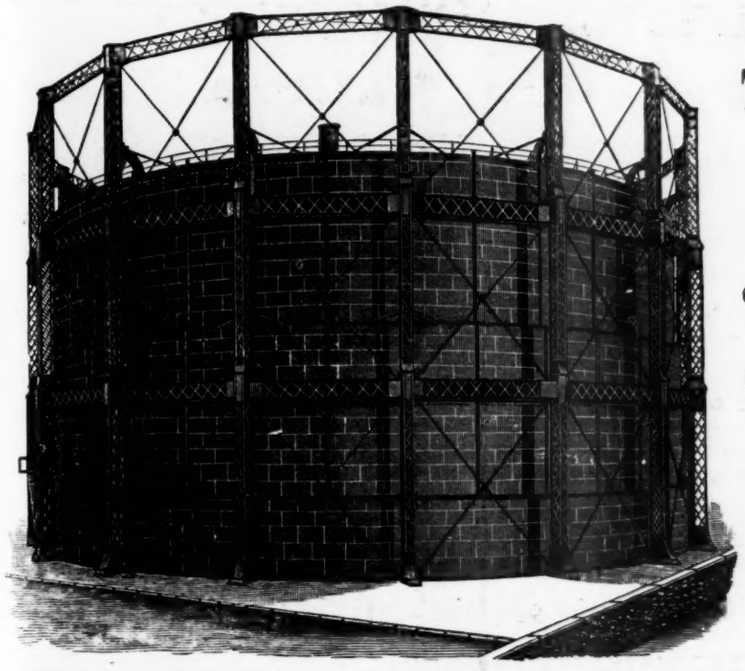

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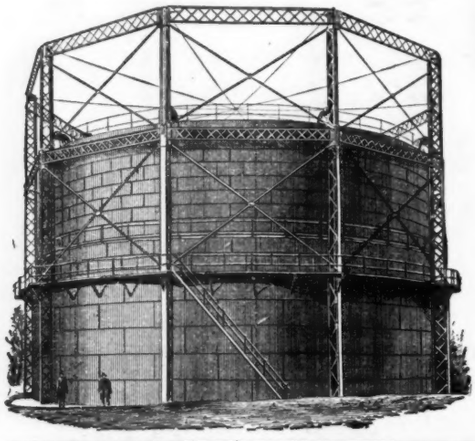

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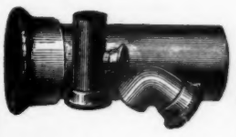

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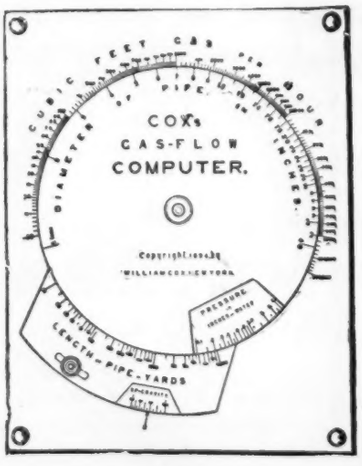

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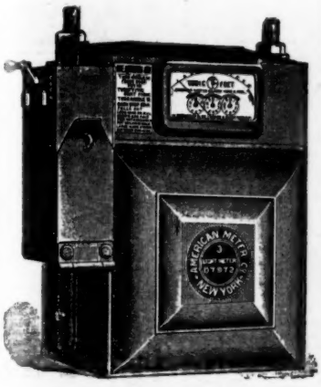

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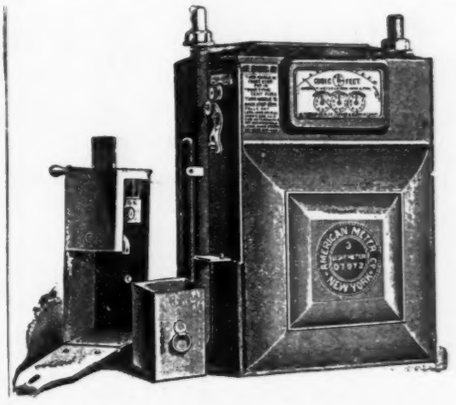

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